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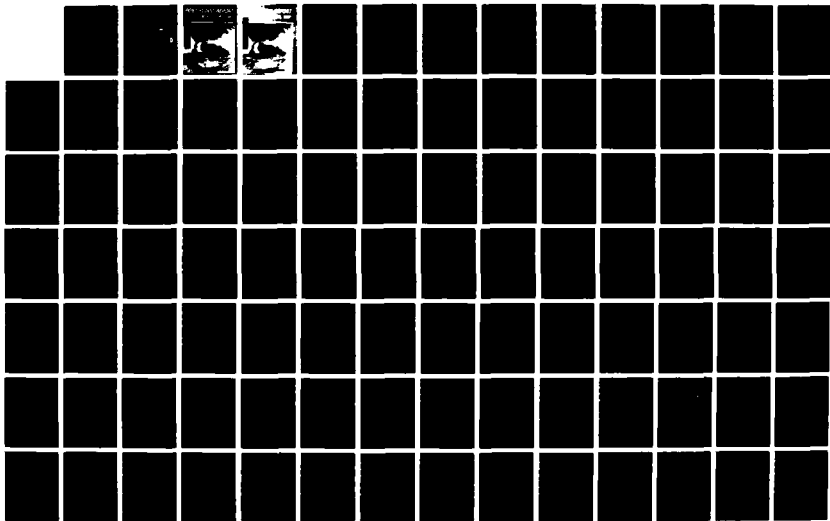
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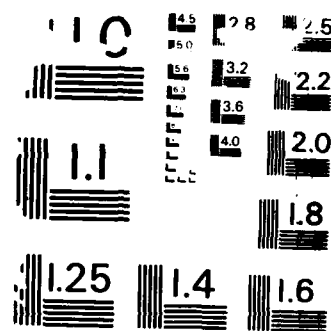
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POST FLOOD REPORT

MARCH/APRIL 1987

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US Army Corps
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F O R E W O R D

This report represents an expeditious effort by the Reservoir Control Center to prepare a hydrologic description of the flood of March - April 1987 and summarize the associated reservoir regulation activities. The event was the most widespread New England flood in approximately 50 years; and this report is intended to provide an overall picture of what occurred at Corps-built flood control projects and also create a document for reference in future years.

The following people were involved in the preparation of this report:

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Appreciation is extended to Lawrence Bergen, Chief, Water Control Branch, who gave valuable assistance to RCC during the flood.

Cover photo of spillway discharge at Knightville Dam taken by Leo Milette on 6 April 1987 at 1320 hours with 1.9 feet of water over the crest.

FLOOD REPORT
MARCH - APRIL 1987

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FLOOD REPORT
MARCH - APRIL 1987

I. INTRODUCTION

A. GENERAL

During a one-week period beginning at the end of March 1987, a pair of intense rainstorms hit most of New England, causing major flooding in Connecticut, Massachusetts, New Hampshire, Vermont and Maine. These two storms, augmented by snowmelt in the mountains and northern areas, resulted in the most widespread flooding in about 50 years. The storms created two separate and significant flood peaks, especially in southern and central regions. Rainfall maps for each event and for the total period are shown in exhibits 1, 2, and 3; rainfall amounts at Corps reservoirs are indicated on exhibit 4. Additional information on antecedent hydrologic conditions is summarized in exhibit 5, which is a Situation Bulletin prepared by RCC, as of 25 March 1987.

B. STORM OF 31 MARCH - 1 APRIL

The month of February and most of March were characterized by very little precipitation and sunny, clear weather. As a result, snow cover throughout New England had been reduced substantially from near record highs at the end of January. This was especially true in southern New England where the snowpack had mostly disappeared, although significant amounts of snow still remained in higher elevations of western Massachusetts and Connecticut and the hilly and mountainous areas of the three northern states. In the week before the first storm, windy and sunny weather caused a reduction of 2 to 3 inches of the water content in the snowpack in the Connecticut River Basin and up to 3 inches in the Merrimack River Basin. This condition increased flows on the main stem of the Merrimack and Connecticut Rivers to about 40 to 50 percent of channel capacity. Exhibit 6, showing the 'latest' printout reading for each GOES station for 30 March at 0808 hours, illustrates this condition.

During the next two days an intense, fast moving storm system buffeted the entire New England area with heavy rainfall, strong southerly winds and temperatures in the fifties and sixties. As a precautionary measure to the forecasted storm, the flood control gates at most Corps reservoirs were throttled to minimum releases on Monday afternoon, 30 March.

The storm system deposited 3 to 5 inches of rain in southern and coastal areas and 2 to 3 inches over much of northern New Hampshire and Vermont, both of which had 3 to 5 inches of water equivalent in their remaining snowpacks.

This rainfall caused significant rises in all rivers. However, water levels in the smaller basins of southern New England such as the Blackstone, Thames and Naugatuck remained below flood stage, due in part to Corps reservoirs and in part to dry antecedent conditions with no snowmelt. Active snowmelt in the hills and mountains of northern and central Vermont and New Hampshire combined with the rainfall to create flood conditions in many watersheds within the Connecticut and Merrimack Basins. The entire length of the Connecticut River from White River Junction, Vermont to Long Island Sound rose to several feet above flood stage. The Pemigewasset River upstream of Franklin Falls Dam also experienced damaging flood conditions, and the Merrimack River at Lowell, Massachusetts crested at flood stage.

Corps reservoirs reduced stages on many of the larger rivers and streams during this flood, as flood control storage utilized ranged from about 30 to 70 percent at reservoirs in the Connecticut River Basin and about 40 to 75 percent at reservoirs in the Merrimack River Basin. Regulation at Corps reservoirs in the remaining basins resulted in lesser amounts of flood control storage being used. A watershed map of New England, located in the front of Appendix A of this report, shows the locations of all Corps-built dams.

This event also created flood conditions in many of the rivers of western and central Maine, with serious flooding on the Androscoggin, Saco and Penobscot Rivers. In addition, discharges on the Kennebec River exceeded the previous record flood of March 1936 along its entire length from about Madison, Maine to its mouth. Since there are no Corps flood control reservoirs in the State, the only reference to this event for Maine will be limited to 'damages prevented' by Corps-built local protection projects. The U.S. Geological Survey in Augusta, Maine is preparing a hydrologic report on flooding in the State.

C. STORM OF 4-8 APRIL

On 4 April, another intense but slow moving storm hit southern and much of central New England with heavy rainfall ranging from 4 to 7 inches. This 4-day storm had heavier precipitation over a larger area, creating a classic one-two flood punch. Corps flood control reservoirs were again throttled to minimum releases before the onslaught of this

second storm, and the resulting inflows into already partially full reservoirs resulted in record pool levels at 20 projects and near record amounts at eight others. In six cases (Knightville, Townshend, Ball Mountain, Surry Mountain, Otter Brook, and Edward MacDowell) flood control storage was exceeded, resulting in uncontrolled spillway discharge.

The extensive runoff created widespread flooding conditions, particularly within the middle and lower reaches of the Merrimack and Connecticut River Basins. At Lowell, MA the Merrimack River rose to its highest level since September 1938; and the Nashua, Concord and Spicket Rivers experienced serious flooding. The Connecticut River from Brattleboro, Vermont to its mouth again rose several feet above flood levels; and flooding was experienced in the West, Ashuelot, Deerfield, Westfield and Farmington River watersheds. Within the Naugatuck, Shetucket, Quinebaug, French and Blackstone River watersheds the main rivers rose to bankfull capacities, but no significant flooding was experienced in areas located downstream of Corps reservoirs.

Exhibit 7 shows a printout of GOES readings from each station taken during the flood on 7 April. Exhibit 8 lists the maximum water levels during this event at all 35 Corps-built reservoirs. Graphical reservoir summaries for the 28 "manned" reservoirs, showing precipitation, pool levels and discharges for the 31-day period from 31 March to 30 April are presented on exhibits 9 through 36. Also, a tabulation of selected flood peaks at gages in the Merrimack River Basin and in other watersheds is included in exhibit 37.

II. RESERVOIR REGULATION

A. GENERAL

Reduction of floodflows resulting from Corps reservoirs was significant during both events at all downstream areas. These reductions, for purposes of computing damages prevented, are tabulated for selected locations in exhibits 38a and 38b. In addition, Appendix A of this report includes RCC worksheets showing pool levels and peak inflows at Corps reservoirs during both floods. The worksheets include other graphical representations of observed and computed natural flows (without Corps reservoirs) at selected river index stations for both events. There are 48 worksheets contained in Appendix A.

A discussion of Corps regulation activities in each basin is included in the following paragraphs.

B. CONNECTICUT RIVER BASIN

The Connecticut River in Massachusetts and Connecticut experienced damaging floodflows during both events, in spite of the regulation activities at the 16 Corps reservoirs within the basin. A summary of the observed and computed natural flows at 4 locations along the main stem follows. Refer to the worksheets in Appendix A for background.

<u>Location</u>	<u>Peak #1</u>		<u>Peak #2</u>	
	<u>Observed</u> (cfs)	<u>Natural</u> (cfs)	<u>Observed</u> (cfs)	<u>Natural</u> (cfs)
Montague City, MA	128,000	160,000	109,000	123,000
Holyoke, MA	125,000	157,000	113,000	129,000
Thompsonville, CT	141,000	174,000	134,500	153,000
Hartford, CT	131,500	163,500	139,200	159,500

Although considerable snowmelt occurred in the Vermont watersheds during the first flood, the rainfall totals for both storms were somewhat less at the three upper Corps reservoirs located in Vermont, namely, Union Village, North Hartland and North Springfield; and these projects stored all the runoff during both floods, with the result that downstream areas along the Ompompanoosuc, Ottauquechee and Black Rivers did not experience flood problems. After downstream Connecticut River flooding receded, controlled reservoir releases were initiated to start the evacuation of stored floodwaters.

Ball Mountain and Townshend Lakes, located on the West River in southern Vermont, had stored significant runoff from the first event; whereupon, heavy rainfall during the second storm resulted in enough flood runoff to create spillway discharge at both projects. Townshend started spilling on 5 April and continued for four days until 9 April. Spillway discharge at Ball Mountain started early on 6 April and continued until 8 April. Fortunately the peak discharges (10,000± cfs at Townshend and 5,800± cfs at Ball Mountain) did not result in serious flood problems along the West River because these discharges occurred just after downstream West River floodflows had receded.

In the Ashuelot River watershed of New Hampshire, the Surry Mountain and Otter Brook Reservoirs experienced spillway discharges as a result of the second storm, occurring

from 6 to 9 April at Surry Mountain and from 7 to 10 April at Otter Brook. Maximum releases from Surry Mountain rose to about 2,250 cfs, which exceeded the downstream channel capacity of 1,250 cfs. This was the highest discharge from the project since its completion in the early 1940's. Along the Ashuelot River in Keene significant flood damage from the Surry Mountain spillway discharges was experienced. After Surry's spillway flows ended, the evacuation of the reservoir floodwaters was a lengthy procedure because the channel capacity is limited by the river's flat gradient through the city of Keene. However, with the understanding and approval of local officials and citizenry, RCC was able to make regulated releases (lasting about a week) that exceeded the 1,250 cfs channel capacity. This was accomplished in order to regain some flood control storage in the reservoir and prevent another spillway discharge in case of a followup rainstorm.

Otter Brook started spilling on 7 April in the afternoon and discharges slowly increased to about 750 cfs during the next 18 hours. Although this peak discharge was greater than the normal maximum regulated release rate of 650 cfs, it did not cause downstream damages along Otter Brook, along the Branch or along the Ashuelot River downstream of Keene. The communities along the Ashuelot downstream of Keene were fortunate that the spillway discharges from both reservoirs occurred after the flood runoff from the uncontrolled areas in the watershed had significantly receded and therefore did not create additional flood problems.

Rainfall in the Millers and Chicopee River watersheds was considerable from both storms; however, the impact of snowmelt was minimal. Although record pool levels were reached at Birch Hill, Tully and Barre Falls, the reservoirs were able to store the flood runoff from both events. Flows along the main stem of the Millers, Ware and Chicopee Rivers remained below flood levels. Most of the released floodwaters from Barre Falls were subsequently diverted by the Massachusetts Water Resources Authority's Coldbrook Diversion, on the Ware River, into Quabbin Reservoir for water supply.

The two Corps reservoirs within the Westfield River watershed, namely, Knightville and Littleville, experienced record levels with spillway discharge occurring at Knightville for the second time since its construction in the early 1940's. This was the first reservoir to have spillage during the flood, and it continued from the morning of 5 April until the evening of 7 April. While Knightville was spilling, Littleville Lake floodwaters rose to 89 percent of capacity (it should be noted, however, that Littleville's storage capacity of 8.3 inches is much greater than Knightville's 5.7

inches). Peak discharges from Knightville reached about 5,500 cfs, the largest discharge in more than 45 years; however, this did not create serious flooding problems in Huntington, Westfield or other communities along the Westfield River, because of the timing and desynchronization with floodflows from the uncontrolled downstream drainage areas.

Within the Farmington River watershed, the Corps has constructed three flood control reservoirs. Colebrook River Lake is the largest and includes storage for water supply and flood control. Just before the first event, the water supply pool was only partially full and could take 2 inches of runoff from its upstream watershed before flood control storage was affected. During both flood events, Colebrook Reservoir stored the entire runoff (except for minimum required releases) from its 118-square mile drainage area. The reservoir level rose to 41 percent of flood control capacity and stored an amount of runoff equal to 6.7 inches. In spite of the regulation activity, the lower reaches of the Farmington River experienced extensive damage, particularly in the large flood plain between River Glen and Tariffville. The two other dams (Mad River and Sucker Brook), which have comparatively small drainage areas and ungated conduits with limited discharge capacities, helped to minimize flooding on the Mad River in Winsted and to a lesser degree helped to reduce flows on the Farmington River.

Five of the six reservoirs having spillway discharges are located in the Connecticut River Basin. A tabulation of spillway discharge data is therefore included for reference on the following page.

APRIL 1987 SPILLWAY DISCHARGES

Project	Approximate Times of Spillway Discharge				Peak Pool Level		Height Above Spillway Crest (feet)	Maximum Spillway Discharge (cfs)
	Start		Finish		Feet	Date		
	Date	Hours	Date	Hours				
Knightville	5 Apr	0800	7 Apr	2000	132.4	5 Apr	2.4	4,600±
Townshend	5 Apr	1000	9 Apr	0100	98.6	7 Apr	2.6	7,000±
Ball Mountain	6 Apr	0300	8 Apr	0730	213.9	7 Apr	2.4	2,700±
Edward MacDowell	6 Apr	0800	12 Apr	1200	949.8*	8 Apr	*	800±
Surry Mountain	6 Apr	1830	9 Apr	1630	66.1	7 Apr	1.1	1,100±
Otter Brook	7 Apr	1600	10 Apr	0200	99.4	8 Apr	1.4	750±

* Reservoir level rose 3.8 feet higher than spillway crest; however, the restriction created by the Sargent Camp Road resulted in about 1.8 feet of water discharging over the spillway into Ferguson Brook.

NOTE: Maximum reservoir releases from Knightville, Townshend, Ball Mountain and Surry Mountain include conduit releases and spillway discharge.

C. MERRIMACK RIVER BASIN

During the first flood, discharges in the Merrimack River from Franklin, NH to Nashua, NH were kept below flood levels; downstream of the Massachusetts State line the river peaked at about flood stage. Nonetheless, heavy rains of the second event, particularly over the southern and central areas of the basin, created widespread flooding resulting in the highest discharge at Lowell, MA since September 1938. A summary of the observed and computed natural flows for both events at 4 gaging stations on the main stem and at 2 gages on New Hampshire tributaries follows (also refer to worksheets in Appendix A).

<u>Location</u>	<u>Peak #1</u>		<u>Peak #2</u>	
	<u>Observed</u> (cfs)	<u>Natural</u> (cfs)	<u>Observed</u> (cfs)	<u>Natural</u> (cfs)
Franklin NH	14,000	59,000	-	-
Concord, NH	21,000	72,500	29,000	50,000
Goffs Falls, NH (Manchester)	38,000	83,500	48,000	68,500
Lowell, MA	55,200	92,500	85,000	103,000
Contoocook R. at Riverhill, NH (Penacook)	6,500	22,400	11,500	27,000
Piscataquog R. at Goffstown, NH	6,450	8,900	7,600	11,500

It is of special interest to note that RCC files indicate the computed natural peak flows of 92,500 cfs and 103,000 cfs at Lowell, MA were exceeded in this century only by the March 1936 peak of 173,000 and September 1938 peak of 121,000 cfs. The flood of June 1984 had an observed peak of 60,300 cfs, with a computed natural of 90,000 cfs.

The most important flood control dam in New England is the Franklin Falls project, located on the Pemigewasset River in Franklin, New Hampshire. During the first event the peak inflow into the reservoir reached a record-tying 55,000 cfs, which was caused by 2 to 4 inches of intense rainfall and melting of a ripe snowpack. Regulated outflows were limited to 10,000 cfs until the morning of 2 April, and then were

gradually increased to 17,000 cfs during the next 48 hours. On 3 April, the reservoir peaked at elevation 375.4 feet, 0.3 foot less than the March 1953 record level, utilizing 76 percent of storage. This was of serious concern, particularly during the second event because this project has much less storage than all other reservoirs, only 2.8 inches of runoff for its 1,000-square mile drainage area. Fortunately, rainfall in the Pemigewasset watershed for the second storm was only about 2 inches, and available flood storage was not exceeded. During this second flood the regulated releases were varied between 14,000 cfs and 11,000 cfs, as RCC maintained the pool level below 370 feet, so as to have a reserve storage available in case of additional rainfall. The Pemigewasset watershed was saturated and subject to rapid runoff, with the real possibility of uncontrolled spillway discharge occurring, creating additional flooding along the entire length of the Merrimack, particularly in New Hampshire. It is noted the normal maximum release rate at Franklin Falls is 18,000 cfs.

The remaining Corps dams (MacDowell, Hopkinton, Everett and Blackwater) are located on the westerly side of the basin, within the Contoocook and Piscataquog River watersheds. Rainfall for both storms was quite heavy, and two flood peaks occurred. MacDowell Dam, located on Nubanusit Brook is regulated primarily to provide protection to Peterboro and other communities along the upper Contoocook River, and during both floods the floodgates were throttled to minimum releases. However, on 6 April, floodwaters in the reservoir rose above spillway crest elevation and remained above crest level until 12 April. Location of the MacDowell spillway is quite unique in that it is located at the opposite end of the reservoir about 3 miles northeast of the dam. The reservoir fills up, rises up over a local roadway into Halfmoon Pond, flows over the spillway, empties into Davis and Ferguson Brooks and then into the Contoocook River, downstream of Peterboro. It was observed the roadway elevation was about 2 feet higher than the spillway crest and until the roadway was overtopped no significant spillway discharge occurred. Eventually the road was overtopped and partially washed out, and the water level at the weir crest rose to about 1.8 feet, with a spillway discharge of about 800 cfs. (Followup hydraulic studies will be undertaken to determine what modifications to the existing road are necessary to ensure no impact on the dam's freeboard requirements). When downstream Contoocook River flooding receded, controlled releases from the dam were made into Nubanusit Brook and maintained at full channel capacity for more than two weeks until floodwaters were emptied.

Hopkinton Dam, located on the Contoocook River, and Everett Dam on the Piscataquog River, are a dual reservoir system connected by two canals, that act as two separate reservoirs during minor floods, and as a single reservoir during moderate and major floods. In the larger events, the Contoocook River floodwaters enter the Hopkinton pool and are then diverted through the canals into the Everett pool. When the Hopkinton pool level rises above elevation 401 feet floodwaters are diverted into the Everett reservoir via the canals and unless the Everett reservoir level rises above 401 feet msl, all Contoocook River floodwaters that enter the Everett pool have to be released into the Piscataquog River. The channel capacity downstream of Everett Dam is about 1,500 cfs, whereas the channel capacity downstream of Hopkinton Dam is about 7,000 cfs.

During the early morning hours of 7 April, the regulated releases from Hopkinton were only 460 cfs because of flood conditions along the lower Merrimack River. However, when it appeared that spillway discharge at Hopkinton would probably occur within the next 24 hours, the discharges were gradually increased so that by 2400 hours on 7 April, the conduits were releasing more than 7,100 cfs. The pool level continued to rise slowly until it crested at 415.8 feet at 2300 hours on 8 April, with a release rate of 7,530 cfs. Elevation 415.8 is only 0.2 foot below the Hopkinton spillway crest and 2.2 feet below the Everett spillway. If the Hopkinton pool had continued to rise above spillway crest, the conduit releases would have been reduced to 6,500 cfs; if the pool had risen above 417 feet, the conduit release would have been further reduced to 5,000 cfs. This regulation sequence would have: (1) utilized the 2 feet of surcharge storage above the Hopkinton spillway crest, thus delaying the passage of extra floodwaters down the Contoocook River, (2) prevented flows down the Contoocook River from rising above 7,500 cfs, and (3) reduced the threat of discharge over the Everett spillway.

During the evening hours of 7 April releases from Everett were increased from minimal releases of about 50 cfs so that by noontime on 8 April, conduit discharges in excess of 1,500 cfs had been reached. Because of the tremendous storage of both Piscataquog and Contoocook River floodwaters behind Everett Dam, and the downstream channel capacity, it took more than 4 weeks to get back to normal levels.

Inflows into the Blackwater Reservoir during the second event also caused a record storage (90 percent of capacity) and a pool stage that came within 1.9 feet of spillway crest. From a flood regulation standpoint though, this was not a

condition in which spillway discharge was imminent, because it still left an amount of storage equivalent to about 0.75 inch of runoff from the 128-square mile drainage area. This meant that significant reservoir releases could be delayed for several days, while large releases from Hopkinton could be maintained and runoff from uncontrolled downstream areas continued to recede.

D. THAMES RIVER BASIN

The Thames River basin, consisting of the Shetucket, Quinebaug and French River watersheds, experienced two distinct peak discharges as a result of the two storms. The larger of the two events was generally the first, and was caused by 3 to 5 inches of intense rainfall which fell in less than 48 hours. Neither event was hydrologically unusual. However, because of the closeness of the two storms, there was not much opportunity to release the stored floodwaters from the projects prior to the second storm, and reservoir levels rose to record heights at three dams and near record at two others. There were no significant problems in the communities located downstream of Corps dams, but these rivers remained near bankfull capacity for about two weeks while the reservoirs were being emptied.

On the French River, downstream flows were kept below channel capacity as both Hodges Village and Buffumville rose to maximum storages amounting to 59 and 58 percent full, equivalent to 4.8 and 4.7 inches of runoff from their respective watersheds. French River flows in Webster, Massachusetts peaked at 950 cfs which is about 50 cfs below channel capacity; the computed natural peak was 3,000 cfs.

Observed flows in the upper Quinebaug remained below flood stage because of the large percentage of controlled drainage area provided by East Brimfield and Westville which filled to 47 and 48 percent, respectively, their second highest amounts.

Similar conditions prevailed along the lower Quinebaug River downstream of West Thompson Dam which rose to a record height of 60 percent. For example, the observed peak of 4,100 cfs at Putnam, Connecticut would have been 10,500 cfs and Jewett City's observed flow of 12,000 cfs would have been 17,000 cfs.

Mansfield Hollow Dam, on the Natchaug River upstream of Willimantic, Connecticut had a peak inflow of 10,300 cfs during the first event, and utilized 50 percent of storage during both floods. The regulation activities at the project

kept downstream flows on the Natchaug and Shetucket Rivers well within channel capacities. Peak flows on the Shetucket River at Willimantic would have risen to about 13,500 cfs, which is 50 percent more than channel capacity.

E. NAUGATUCK RIVER BASIN

The Naugatuck River watershed, located in western Connecticut, is a tributary of the Housatonic River. This watershed is highly industrialized, has a drainage area of 312 square miles, and consists of many short, steep tributaries discharging into the Naugatuck River. The Corps has built 7 flood control dams, which control 152 square miles or about 50 percent of the watershed. Four of these dams, namely, East Branch, Hall Meadow, Northfield Brook and Hancock Brook are ungated and discharges are automatically limited by the conduit size.

During both flood events, the watershed experienced two significant rises, with the second being the larger. Flooding occurred on many of the unprotected tributaries and rose to slightly above channel capacity along the lower reaches of the main stem below Beacon Falls, Connecticut.

In the upper watershed, East Branch reservoir levels rose to a record 31 percent full, with 19 percent at Hall Meadow Dam. Both projects kept the river in Torrington below flood stage. At Thomaston Dam, the most important one in the watershed, two separate peak inflows of 6,000 and 10,700 cfs occurred, and floodwaters rose to 34 percent of storage capacity.

Peak storages at Hancock Brook Lake and Northfield Brook Lake reached 37 and 32 percent of capacity, respectively, as both projects also acted with the other reservoirs to reduce downstream floodflows along the Naugatuck River.

At Black Rock Lake, peak storage reached 41 percent, as holdouts helped to reduce flow on the main stem as well as preventing significant flood damage downstream along Branch Brook. Likewise, Hop Brook Lake, which stored 35 percent of capacity, prevented considerable damage downstream along Hop Brook as well as contributing to flood reductions on the Naugatuck River.

As a result of the regulation of the seven reservoirs, flows at the Beacon Falls gage were kept to 10,800 cfs. The computed natural flow would have been 27,000 cfs, or more than twice the channel capacity.

F. BLACKSTONE RIVER BASIN

A record pool level, 25.5 feet and 67 percent of storage, was experienced at the Corps West Hill Dam in the Blackstone River basin during these two storms. As a result of this regulation, peak inflows into West Hill of 1,200 cfs (43 csm) for the first storm and 1,000 cfs (36 csm) for the second storm were held back from flows on the Blackstone River, reducing discharges at Woonsocket, Rhode Island by 10 percent.

III. DAMAGES PREVENTED

Observed flows and computed natural discharges were compiled by RCC for all damage zones downstream of Corps reservoirs and also at Corps local protection projects. A tabulation of this hydrologic information for selected index stations is included in exhibits 38a and 38b. This information was provided to the Corps Economic and Resource Analysis Section for determination of 'damages prevented' by Corps flood control projects. A tabulation of benefits assigned to each project is included as exhibits 39a, 39b and 39c. Total damages prevented by Corps projects in New England during this flood event amounted to \$462,596,000; of this total, about 68 percent (\$314,570,000) was associated with reservoir regulation activities. The benefits for each reservoir were determined by the effects of that reservoir's holdout flow on the computed natural peak flows in each downstream damage zone. Benefits associated with Corps-built local protection projects, based on observed flows at each project, are included and amount to about 32 percent of the total.

The floods of March-April 1987 were unusual because of the nearness of the two important storm events, each of which resulted in significant peak flows in river basins in southern and central New England. Both of these floods were individually large enough to result in considerable "damages prevented" by Corps projects. However, due to the closeness of the two events, flood control benefits associated with regulation activities were based upon the difference between the higher computed natural peak flow and the higher observed peak flow. An example of this concept is illustrated on worksheet A-8 which shows observed peaks of 55,200 and 85,000 cfs at Lowell, MA. Computed benefits were based on the 'damages prevented' between the observed flow of 85,000 cfs and the computed natural peak flow of 103,000 cfs, which were associated with the second flood peak on 7 April. No benefits were claimed for the regulation activities associated with the first flood event, even though the first peak was

reduced from 92,500 to 55,200 cfs, equivalent to a 40 percent reduction.

IV. ADVISORIES

During the floods, NED's Public Affairs Office issued daily releases to the media (television, radio and newspapers) region-wide via "PR News Wire" concerning general flood conditions and Corps activities. In addition to this, special advisories were issued to those media and public officials listed in the Corps-prepared Flood Emergency Plans for eight reservoirs. Such advisories with evacuation notices were issued for all projects where spillway discharge occurred (6 projects) or was anticipated (Hopkinton and Everett). For example, the advisory issued regarding the evacuation of areas downstream of Hopkinton and Everett Lakes is included in exhibit 40.

V. DATA COLLECTION

NED's Water Control Data System consists of a satellite ground receive station and a set of 46 data collection platforms (DCP's) installed at key river gages and flood control dams. Exhibits 41 and 42 provide a location map for these gages and a sketch of a typical gaging station, respectively. DCP's are programmed to transmit river stage and rainfall data randomly in time, and to adapt the frequency with which they transmit according to depth of water. That is, as rivers rise, the DCP's transmit more messages -- from a low of 6 per day to a high of about 48 per day. This mode of operation provides an abundance of data when it is most needed. Prior to the March-April flood, the network was transmitting about six messages per DCP per day; and during the 15-day period surrounding the flood, 8,250 messages were received, for an average of almost 13 messages per DCP per day. This is equal to about 52 seconds of "on-air" time per DCP per day. This rate of reporting was considered sufficient.

One of the most useful products of the GOES data collection system is the printout (called "latest") that tabulates the most recent data from each DCP. This printout is very easy to obtain from the RCC computer, and RCC personnel produced copies of it on the order of 50 times a day at the height of regulation activities. That is one indicator of how important it was to have up-to-date river information. Two

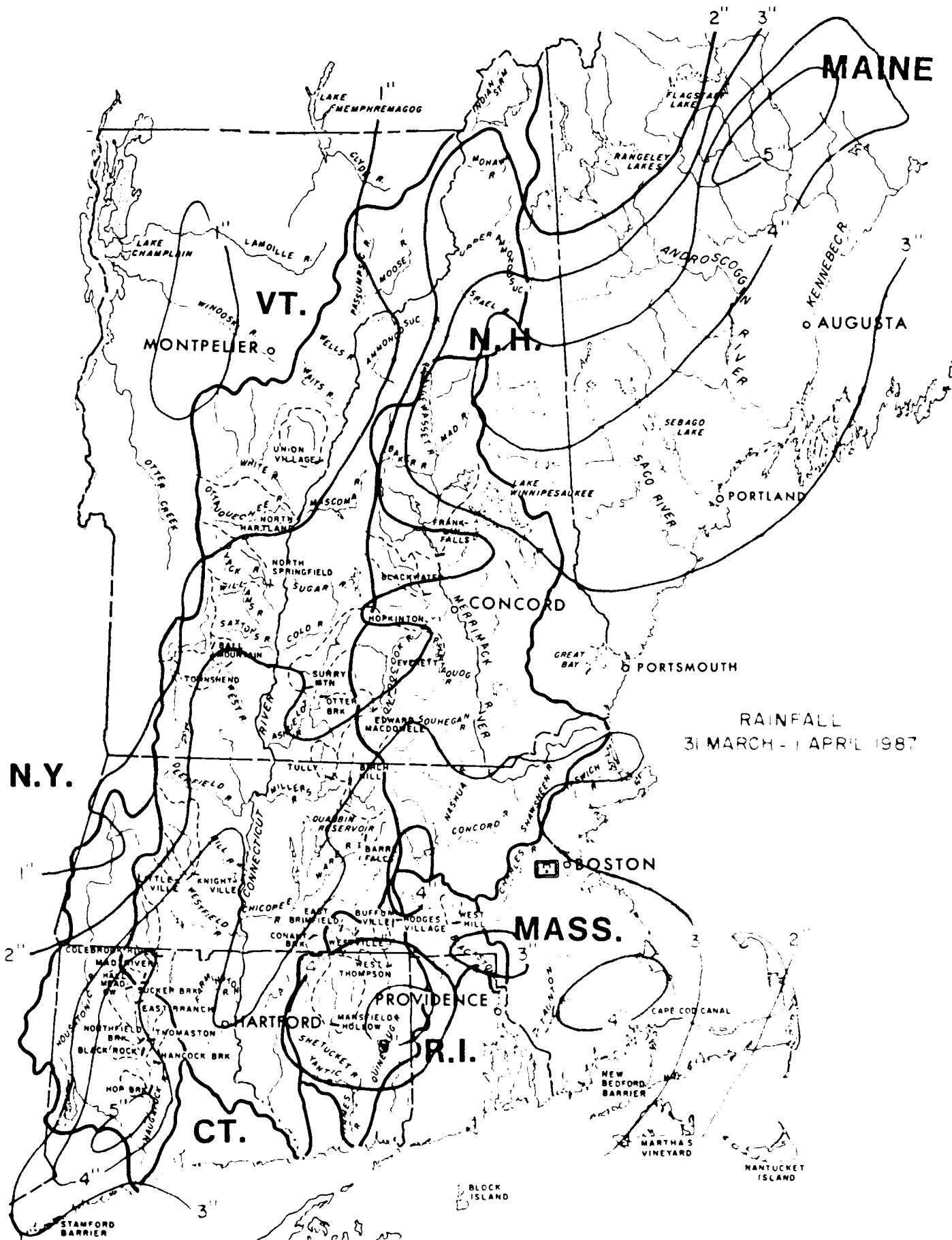
samples of "latest" are attached -- one showing preflood conditions on 30 March 1987 at 0808 hours (exhibit 6) -- and the other showing conditions during widespread flooding on 7 April at 1305 hours (exhibit 7). On the latter printout, riverflows that exceed channel capacity or reservoirs that are quite full are indicated by the word "FLOOD" in the right margin. Rivers that are on the rise but below a preset threshold are indicated by the word "WARN". Another meaningful product of this computer controlled system can be observed on exhibit 43 which lists the gage readings on 4 and 5 April 1987 from Montague City on the Connecticut River. This kind of data is available for each station for any length of time.

Out of NED's 46 data collection platforms, 43 performed well during the flood, and three did not. Two of these (East Branch Dam and Northfield Brook Lake) were not reporting because the manometers had been shut off for the winter due to ice problems and had not yet been turned back on. The third DCP, Deerfield River at West Deerfield, transmitted bad data because of a faulty shaft encoder.

For analysis and long term archiving, all data and most computations from the flood have been separated from routine data and stored in dedicated computer files in the directory "/user4/87flood."

VI. PROJECT MANAGERS AND FIELD PERSONNEL

NED field forces performed in an outstanding manner throughout the flood period; they provided around-the-clock operations of project facilities and hydrologic reports, monitored embankments and structures, patrolled reservoir areas, alerted downstream residents and provided an interface with the public. They were the eyes and ears of our regulation activities and RCC appreciates their contributions. An organizational chart for the reservoirs is shown on exhibit 44.



RAINFALL
31 MARCH - 1 APRIL 1987

ISOHYETES BY R. LAUTZENHEISER
STATE CLIMATOLOGIST
NEW ENGLAND CLIMATIC SERVICE

EXHIBIT 1

FLOOD OF MARCH/APRIL 1987
RAINFALL TOTALS (INCHES)

	31 MARCH-1 APRIL	4-8 APRIL	TOTAL
<u>MERRIMACK RIVER BASIN</u>			
FRANKLIN FALLS	1.85	2.15	4.00
BLACKWATER	1.72	4.41	6.13
MACDOWELL	2.60	6.72	9.32
HOPKINTON	1.86	5.93	7.79
EVERETT	1.99	5.70	7.69
<u>CONNECTICUT RIVER BASIN</u>			
UNION VILLAGE	0.95	1.62	2.57
NORTH HARTLAND	1.56	1.41	2.97
NORTH SPRINGFIELD	1.60	1.90	3.50
BALL MOUNTAIN	2.15	4.15	6.30
TOWNSHEND	2.25	3.36	5.61
SURRY MOUNTAIN	2.21	2.18	4.39
OTTER BROOK	1.88	3.71	5.59
BIRCH HILL	2.55	3.81	6.36
TULLY	2.76	3.90	6.66
BARRE FALLS	3.21	5.10	8.31
KNIGHTVILLE	2.65	5.05	7.70
LITTLEVILLE	3.10	5.10	8.20
COLEBROOK	3.50	5.98	9.48
<u>NAUGATUCK RIVER BASIN</u>			
THOMASTON	3.66	6.17	9.83
BLACK ROCK	3.40	6.27	9.67
HOP BROOK	4.78	5.00	9.78
<u>THAMES RIVER BASIN</u>			
MANSFIELD HOLLOW	4.40	3.70	8.10
BUFFUMVILLE	4.90	4.67	9.57
HODGES VILLAGE	3.97	4.53	8.50
EAST BRIMFIELD	3.98	4.45	8.43
WESTVILLE	4.30	4.45	8.75
WEST THOMPSON	4.40	4.21	8.61
<u>BLACKSTONE RIVER BASIN</u>			
WEST HILL	4.00	5.31	9.31

NEW ENGLAND DIVISION, CORPS OF ENGINEERS

FOR OFFICE USE ONLY
SITUATION BULLETIN 3

Wednesday 25 March 1987

1. In the past two weeks, since the last Bulletin, the unusually dry weather pattern in our area has continued; and since the end of January approximately 7 weeks ago there has been only one period of significant precipitation.

2. Overall the weather has been clear and sunny with cool to mild daytime temperatures in the 40's and 50's and night-time temperatures in the 20's and 30's. This has resulted in a significant reduction in the regions' snowpack through evaporation and ground infiltration, with a minimum of surface runoff occurring.

3. In general there is little or no snow remaining in Rhode Island, eastern and southern Massachusetts and Connecticut and southeastern New Hampshire. Within the following watersheds of southern New England in which Corps flood control reservoirs are located, namely: Blackstone, French, Quinebaug, Shetucket and Naugatuck Rivers, any remaining snowcover is considered minimal and will not contribute to flood conditions created by rainfall.

4. The southern tributaries of the Merrimack River basin (Shawsheen, Concord, Nashua and other watersheds entering the main stem downstream of Nashua NH) have little or no snow remaining and snowmelt would add very little runoff to flood conditions created by rainfall. The central and northern watersheds of the basin - Piscataquog, Contoocook and Pemigewasset have a normal, ripe snowpack with a water content that presently varies from 4"-6".

5. The Connecticut River basin extends from northern New Hampshire to Long Island sound, a distance of about 280 miles. Its topography ranges from the flat coastal plains in CT., to the hilly areas of MA., to the Green and White Mts of VT. and NH. Therefore there is a wide variety of snow cover conditions:

- little or no snow in Connecticut and southern Massachusetts.
- little or no snow in open fields, lower elevations, southerly and westerly exposures of central and northern Massachusetts.
- ripe, normal snow pack in the higher hills and Berkshires as well as northerly exposures and forested areas of central and northern Massachusetts.
- heavy, ripe snow cover in the Vermont watersheds with water contents of 5"-8". However lesser amounts exist in the open fields and southerly exposures.
- average, ripe snowpack in southern and central New Hampshire with water content of 2"-4".

6. Based on RCC personnel observations and discussions with our reservoir project managers, this year's flood potential associated with ice jams is over. Most rivers downstream of Corps reservoirs are ice free or partially ice covered. In those few areas where total ice cover remains, the cover is thin or 'soft'.

7. River levels and discharges at all gaging stations monitored by NED's GOES data collection network continue to remain well below normal for this time of year. A copy of this latest printout is attached for reference; a brief summary of conditions follow:

<u>River Basin</u>	<u>Mainstream Discharges</u>
Merrimack	15-20% of channel capacity
Connecticut	15-20% of channel capacity
Thames(Quinebaug/Shetucket)	20-30% of channel capacity
Housatonic(Naugatuck)	30% of channel capacity
Blackstone	25% of channel capacity

8. Weather forecasts for the next several days indicate light rain or shower activity (1/4"-1/2") for Wednesday night and part of Thursday with a return to fair weather and temperatures in the 50's on Friday. This light rain will not cause any flood problems. However there is a possibility of significant rainfall for late Saturday afternoon and night.

Finegan
JOSEPH FINEGAN
Chief, Reservoir Control Center

GOES RRDCS READINGS DATE: 3/30/87 TIME 8:08

NO.	NAME	D.A. SQ MI	M/D	TIME HR:MIN	DT HRS	STAGE FT	+/- FT/HR	Q CFS	+/- Q/HR	CSM Q/DA	STORM PREC.	NOTE
38	WELLS RIVER	2644	3/30	4:54	.3	6.85	.00	16470.	0.	6.2	.18	
36	WEST HARTFORD	690	3/30	5:16	4.0	8.95	-.04	7158.	-78.	10.4	.25	
35	WEST LEBANON	4092	3/30	7:58	2.8	13.32	-.01	26816.	-27.	6.6		
37	NORTH WALPOLE	5493	3/30	2:29	7.3	17.08	.01	37920.	55.	6.9	.00	
15	KEENE	214	3/30	7:23	1.7	71.58	.00	0.	0.	.0	.00	WARN
7	WEST DEERFIELD	558	3/30	5:42	2.0	7.88	-.05	13744.	-190.	24.6	.00	WARN
6	MONTAGUE CITY	7865	3/30	7:42	1.4	21.33	.24	48120.	943.	6.1		
5	GIBBS CROSSING	199	3/30	5:03	6.1	3.05	.00	448.	-1.	2.3	.00	
17	INDIAN ORCHARD	688	3/30	7:51	2.1	5.80	.00	1250.	0.	1.8	.13	
18	WESTFIELD	497	3/30	7:01	7.2	7.69	.01	3384.	13.	6.8	.00	
16	THOMPSONVILLE	9661	3/30	8:05	6.0	3.67	.01	56621.	162.	5.9		
27	MAD RIVER DAM	18	3/30	6:06	.8	18.10	.00	86.	0.	4.8	.21	CHRG
24	UNIONVILLE	378	3/30	5:02	1.4	6.03	.00	838.	0.	2.2	.00	
20	SIMSBURY *	497	3/30	6:35	3.0	3.99	-.01	996.	-4.	2.0	.13	
19	HARTFORD (NWS)	10480	3/30	8:00	4.5	13.91	.00	52595.	10.	5.0		
39	CAMPTON	58	3/30	7:13	3.2	10.82	-.01	438.	-4.	7.5	22.61	
33	WOODSTOCK	193	3/30	2:07	3.7	4.48	-.01	1233.	-7.	6.4	.00	
34	RUMNEY	143	3/17	23:52		NO DATA RECEIVED IN LAST 18 HOURS						
32	PLYMOUTH	622	3/30	2:52	1.0	4.56	.10	5293.	131.	8.5	.00	
40	BRISTOL	86	3/30	6:58	.7	4.74	.00	740.	0.	8.6	.01	
47	FRANKLIN JCT	1507	3/29	15:55	2.5	7.86	.00	5996.	-7.	4.0		
10	RIVER HILL	760	3/30	7:27	1.8	14.53	.00	5341.	0.	7.0		
3	SOUCOOK	77	3/30	6:44	9.6	8.24	.01	377.	4.	4.9		
11	CONCORD	2385	3/30	7:29	3.4	6.63	.07	9325.	185.	3.9		
8	GOFFSTOWN	202	3/30	6:40	2.2	6.46	.00	1513.	3.	7.5		WARN
9	GOFFS FALLS	3092	3/30	2:31	3.1	7.57	.01	15202.	31.	4.9	.00	
41	SOUHEGAN	171	3/29	22:31	6.0	4.84	-.01	1046.	-4.	6.1	.01	
42	EAST PEPPERELL	316	3/30	3:27	8.6	3.70	.00	1246.	1.	3.9	.00	
14	LOWELL	4635	3/30	7:51	.3	47.11	.00	21706.	0.	4.7		
28	HALL MEADOW DAM	17	3/30	6:58	.1	9.64	.00	123.	0.	7.2	.17	
30	EAST BRANCH DAM	9	11/ 6	10:57		NO DATA RECEIVED IN LAST 18 HOURS						
26	THOMASTON DAM	99	3/30	7:04	5.1	6.30	-.04	282.	-1.	2.9	.00	
31	NORTHFIELD BRK LK	6	3/30	2:59	4.3	5.36	.00	0.	0.	.0	.22	
25	BLACK ROCK LAKE	23	3/30	4:14	7.2	27.28	.00	86.	0.	3.7	.29	
23	HANCOCK BRK LAKE	12	3/30	6:47	.7	2.91	.00	0.	0.	.0	.22	
29	HOP BROOK LAKE	16	3/30	4:47	2.8	19.25	-.01	16.	-1.	1.0	.31	
43	WATERBURY	180	3/30	1:15	4.2	8.03	-.03	623.	-18.	3.5		
22	BEACON FALLS	259	3/30	7:44	3.4	3.41	-.01	700.	-7.	2.7	.00	
21	STEVENSON	1545	3/30	5:00	.1	.73	.00	48.	0.	.0		
2	WEBSTER	85	3/29	22:13	2.5	5.97	.00	355.	0.	4.2	.00	
45	PUTNAM	331	3/30	8:00	2.2	4.40	-.01	1020.	-6.	3.1		
4	JEWETT CITY	715	3/30	4:41	6.4	7.74	.02	1847.	4.	2.6	.00	
1	WILLIMANTIC	401	3/30	7:17	1.7	3.56	.00	744.	0.	1.9		
13	NORTHBRIDGE	139	3/30	0:41	12.2	4.04	.00	496.	-1.	3.6		
12	WOONSOCKET	416	3/30	6:44	3.6	1.24	.00	171.	0.	.4	.00	

6055 RRDCS READINGS DATE: 4/ 7/87 TIME 13:05

NO.	NAME	D.A. SQ MI	M/D	TIME HR:MIN	DT HRS	STAGE FT	+/- FT/HR	Q CFS	+/- Q/HR	CSM Q/DA	STORM PREC.	NOTE
38	WELLS RIVER	2644	4/ 7	12:41	1.9	7.48	.01	19020.	43.	7.2	.51	
36	WEST HARTFORD	690	4/ 7	12:37	5.3	10.00	.04	9585.	92.	13.9	1.43	WARN
35	WEST LEBANON	4092	4/ 7	11:28	.2	15.43	-.18	34920.	-720.	8.5		WARN
37	NORTH WALPOLE	5493	4/ 7	12:21	2.0	22.35	.07	59298.	324.	10.8	1.50	
15	KEENE	214	4/ 7	13:01	1.1	73.26	.00	0.	0.	.0	.00	FLOOD
7	WEST DEERFIELD	358	4/ 7	13:04	1.4	8.16	-.07	14840.	-286.	26.6	.01	FLOOD C
6	MONTAGUE CITY	7865	4/ 7	12:29	1.0	33.00	.13	106500.	793.	13.5		FLOOD
5	GIBBS CROSSING	199	4/ 7	10:48	3.7	5.66	.01	2715.	5.	13.6	.00	FLOOD
17	INDIAN ORCHARD	688	4/ 7	11:13	5.5	9.69	.06	5695.	90.	8.3	1.59	
18	WESTFIELD	497	4/ 7	12:10	.7	13.22	.00	11630.	0.	23.4	.00	FLOOD
16	THOMPSONVILLE	9661	4/ 7	10:28	.2	7.79	.00	128178.	0.	13.3		WARN
27	MAD RIVER DAM	18	4/ 7	12:14	.9	73.23	-.05	417.	0.	23.1	3.83	FLOOD C
24	UNIONVILLE	378	4/ 7	11:27	.0	173.80	*****	495086.	*****	*****	81.92	NVLD CH
20	SIMSBURY *	497	4/ 7	13:01	.1	13.85	.30	15400.	1200.	31.0	2.78	
19	HARTFORD (NWS)	10480	4/ 7	12:05	.7	26.04	.03	135320.	223.	12.9		FLOOD
39	CAMPTON	58	4/ 7	10:26	3.3	11.50	-.01	1047.	-13.	18.1	1.03	
33	WOODSTOCK	193	4/ 7	10:20	5.0	6.03	-.05	3002.	-73.	15.6	.00	
34	RUMNEY	143	4/ 7	9:58	6.2	4.17	.00	1739.	0.	12.2	.98	
32	PLYMOUTH	622	4/ 7	9:37	2.0	8.12	-.11	10754.	-192.	17.3	.00	WARN
40	BRISTOL	86	4/ 7	12:04	3.5	6.75	-.05	1784.	-28.	20.7	1.58	WARN
47	FRANKLIN JCT	1507	4/ 7	11:40	.8	13.57	.01	17096.	23.	11.3		WARN
10	RIVER HILL	760	4/ 7	12:48	.2	21.56	.00	18350.	0.	24.1		NVLD
3	SOUCOCK	77	4/ 7	12:37	.9	9.96	.13	1028.	70.	13.4		
11	CONCORD	2385	4/ 7	12:59	1.2	12.45	.00	25825.	0.	10.8	2.28	WARN
8	GOFFSTOWN	202	4/ 7	12:54	.4	9.25	-.05	4495.	-68.	22.3		FLOOD
9	GOFFS FALLS	3032	4/ 7	12:30	.4	14.06	-.07	46328.	-360.	15.0	3.84	FLOOD
41	SOUHEGAN	171	4/ 7	8:30	6.7	9.40	-.03	5522.	-36.	32.3	.49	FLOOD
42	EAST PEPPERELL	316	4/ 7	9:44	1.9	14.27	.00	8548.	0.	27.1	4.81	NVLD
14	LOWELL	4635	4/ 7	12:32	.4	57.21	.00	89048.	0.	19.2		FLOOD
28	HALL MEADOW DAM	17	4/ 7	13:04	.3	20.84	1.08	319.	4.	18.8	10.39	WARN CH
30	EAST BRANCH DAM	9	11/ 6	10:57		NO DATA RECEIVED IN LAST 18 HOURS						
26	THOMASTON DAM	99	4/ 7	13:00	.3	73.22	-.16	1446.	0.	14.9	.00	FLOOD
31	NORTHFIELD BRK LK	6	4/ 7	8:28	3.2	5.27	.00	0.	0.	.0	3.19	
25	BLACK ROCK LAKE	23	4/ 7	12:50	.3	71.31	-.39	281.	-4.	12.2	5.09	FLOOD
23	HANCOCK BRK LAKE	12	4/ 7	12:59	.2	16.31	.00	277.	0.	23.1	4.02	WARN
29	HOP BROOK LAKE	16	4/ 7	12:42	.9	49.83	-.15	223.	0.	13.9	4.87	FLOOD
43	WATERBURY	180	4/ 7	12:29	1.3	11.78	.18	4518.	283.	25.1		WARN
22	BEACON FALLS	259	4/ 7	12:59	1.5	7.33	.03	4568.	46.	17.6	.00	WARN
21	STEVENSON	1545	4/ 7	9:16	.2	13.39	.18	21137.	624.	13.7		WARN
2	WEBSTER	85	4/ 7	12:22	.7	8.41	-.03	972.	-9.	11.4	.00	FLOOD
45	PUTNAM	331	4/ 7	13:05	.7	8.13	.03	3660.	26.	11.1		WARN
4	JEWETT CITY	715	4/ 7	11:34	1.7	13.53	.02	8246.	24.	11.5	.00	WARN
1	WILLIMANTIC	401	4/ 7	12:04	3.2	8.20	.03	4777.	36.	11.9		WARN
13	NORTHBRIDGE	139	4/ 7	12:48	.3	9.17	-.04	3439.	-28.	24.7		FLOOD
12	WOONSOCKET	416	4/ 7	11:01	1.0	1.14	-3.74	146.	-2226.	.4	.00	

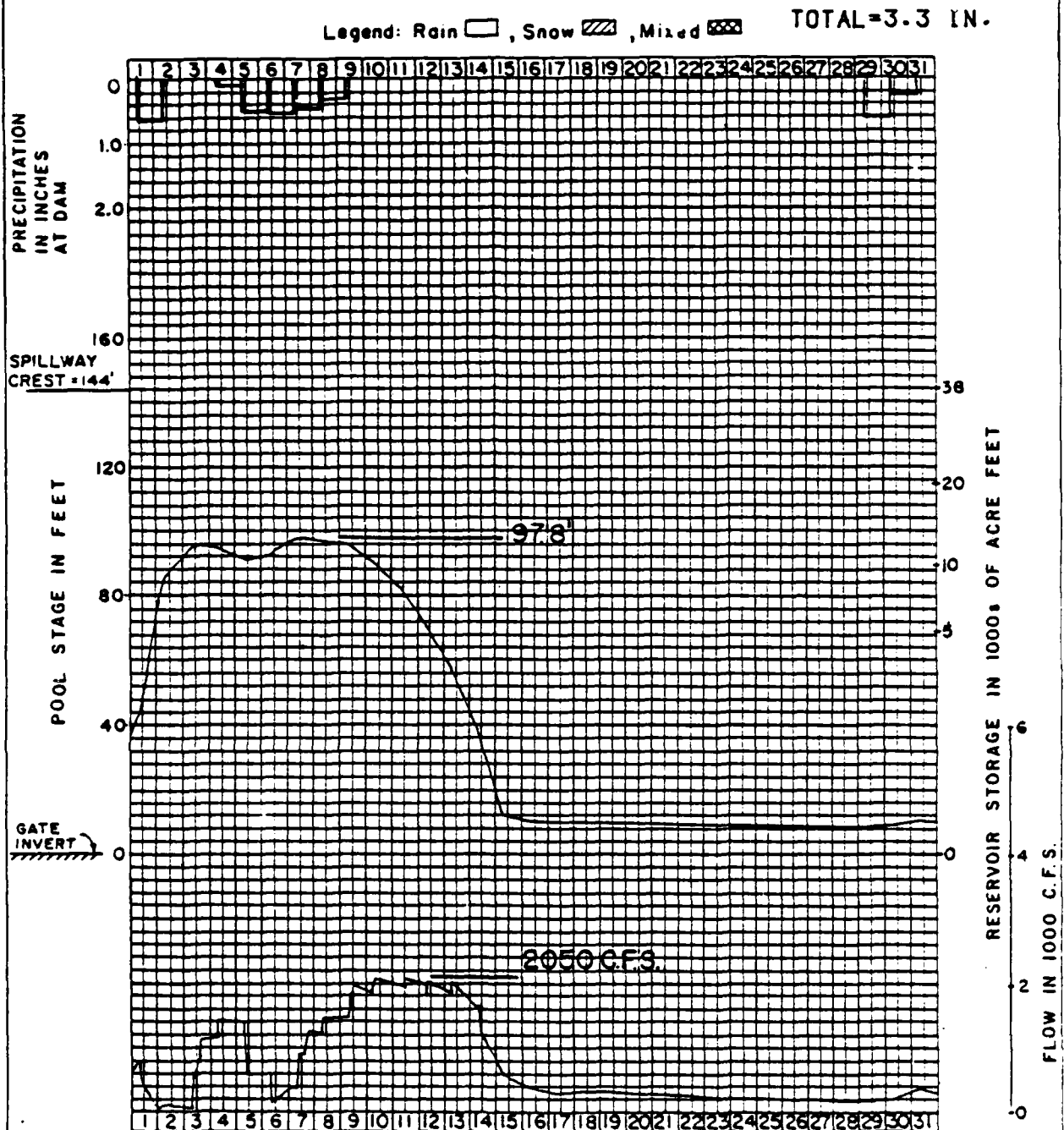
MAXIMUM STORAGE FOR NEW ENGLAND DIVISION

FLOOD CONTROL RESERVOIRS DURING THE MARCH-APRIL 1967 FLOOD

PROJECT	DRAINAGE	PEAK	PEAK STAGE	FLOOD CONTROL			
	AREA	STAGE	RANKING	STORAGE UTILIZED			
	SQ. MI.			ACRE-Feet	MILLION GALLONS	INCHES	PERCENT FULL
<u>Connecticut River Basin</u>							
UNION VILLAGE	126	97.8	4	12,600	4,100	1.9	34
NORTH HARTLAND	220	135.8	1	48,800	15,900	4.2	71
NORTH SPRINGFIELD	158	85.2	1	40,300	13,200	4.8	82
BALL MOUNTAIN	172	213.9	1	54,300	17,700	5.9	100+
TOWNSHEND	106(net)	98.6	1	35,000	11,400	6.2	100+
SURRY MOUNTAIN	100	66.1	1	32,800	10,700	6.1	100+
OTTER BROOK	47	99.4	1	18,100	5,900	7.3	100+
BIRCH HILL	175	33.8	1	40,500	13,200	4.3	80
TULLY	50	35.3	1	12,600	4,100	4.8	62
BARRE FALLS(1)	55	801.4	1	16,700	5,400	5.6	72
CONANT BROOK	7.8	17.7	6	250	80	0.6	6
KNIGHTVILLE	162	132.4	1	51,500	16,800	6.3	100+
LITTLEVILLE(1)	52	571.7	1	21,000	6,800	7.7	89
COLEBROOK(1)	118	732.8	5	43,000(2)	14,000(2)	6.7(2)	41
HAD RIVER	18	74.5	2	2,360	770	2.5	26
SUCKER BROOK	3.4	24.9	2	340	110	1.9	24
<u>Merrimack River Basin</u>							
FRANKLIN FALLS(1)	1000	375.4	2	116,100	37,800	2.2	76
BLACKWATER(1)	128	564.1	1	40,900	13,300	6.0	90
HOPKINTON-EVERETT(1)	446(net)	415.8	1	154,000	50,200	6.5	95
HACDOWELL(1)	44	949.8	1	16,200	5,300	7.0	100+
<u>Naugatuck River Basin</u>							
THOMASTON	70.7(net)	75.6	3	14,300	4,700	2.7	34
BLACK ROCK	20.4	79.0	3	3,600	1,200	3.6	41
HOP BROOK	16.4	50.5	4	2,500	800	3.0	35
HANCOCK BROOK	12	19 (est)	2	1,400	460	2.2	37
NORTHFIELD BROOK	5.7	62 (est)	2	750	240	2.5	32
HALL MEADOW	17.2	21.6	2	1,800	590	2.0	19
EAST BRANCH	9.3	39.8	1	1,330	430	3.2	31
<u>Thames River Basin</u>							
EAST BRIMFIELD	67.5	26.0	2	14,000	4,600	3.9	47
WESTVILLE	32(net)	49.2	2	5,300	1,700	3.1	48
WEST THOMPSON	74(net)	40.9	1	15,400	5,000	3.9	60
HODGES VILLAGE	31.1	27.4	1	7,900	2,600	4.8	59
BUFFUMVILLE	26.5	32.5	1	6,500	2,100	4.7	58
HANSFIELD HOLLOW	159	46.8	4	25,500	8,300	3.0	50
<u>Blackstone River Basin</u>							
WEST HILL	28	25.5	1	8,350	2,700	5.6	67

NOTES (1) Elevation of the pool is in feet NGVD.
(2) Volume of runoff stored during flood event

EXHIBIT 8



31 MARCH - 30 APRIL 1987

MONTHLY RESERVOIR OPERATION

UNION VILLAGE RESERVOIR

CONNECTICUT RIVER BASIN

D.A. = 126 SQ. MILES

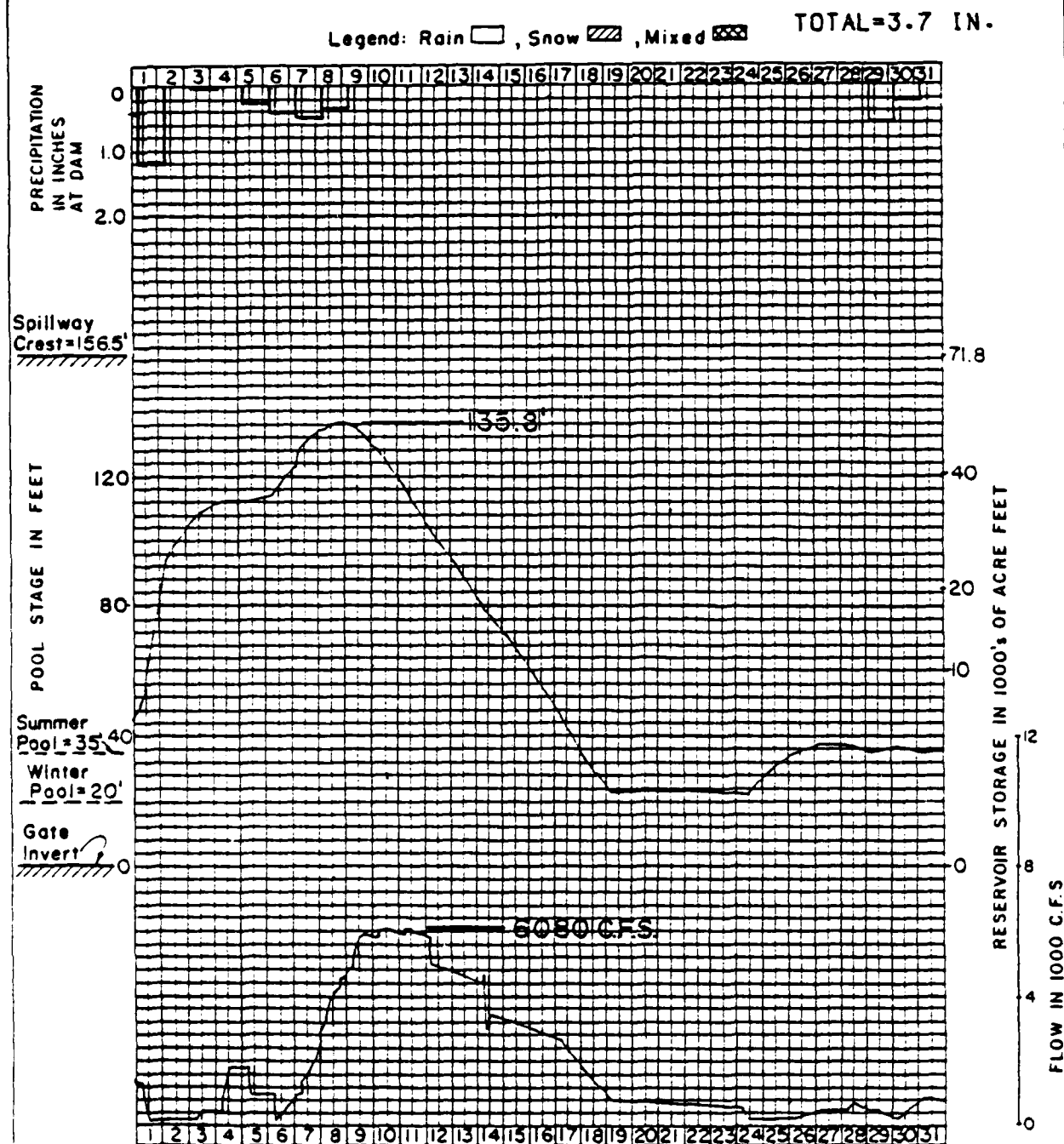
Ist R.O. = 6720 Ac-Ft

NEW ENGLAND DIVISION

WALTHAM, MASS.

	ELEVATION	STAGE	GROSS
	MSL.	FEET	STORAGE
			AC-FT
Gate Invert	420	0	0
Permanent Pool	NONE	—	—
Spillway Crest	564	144	38,000

Outlet Capacity at Full Pool = 7,800 C.F.S.



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MONTHLY RESERVOIR OPERATION

NORTH HARTLAND RESERVOIR

CONNECTICUT RIVER BASIN

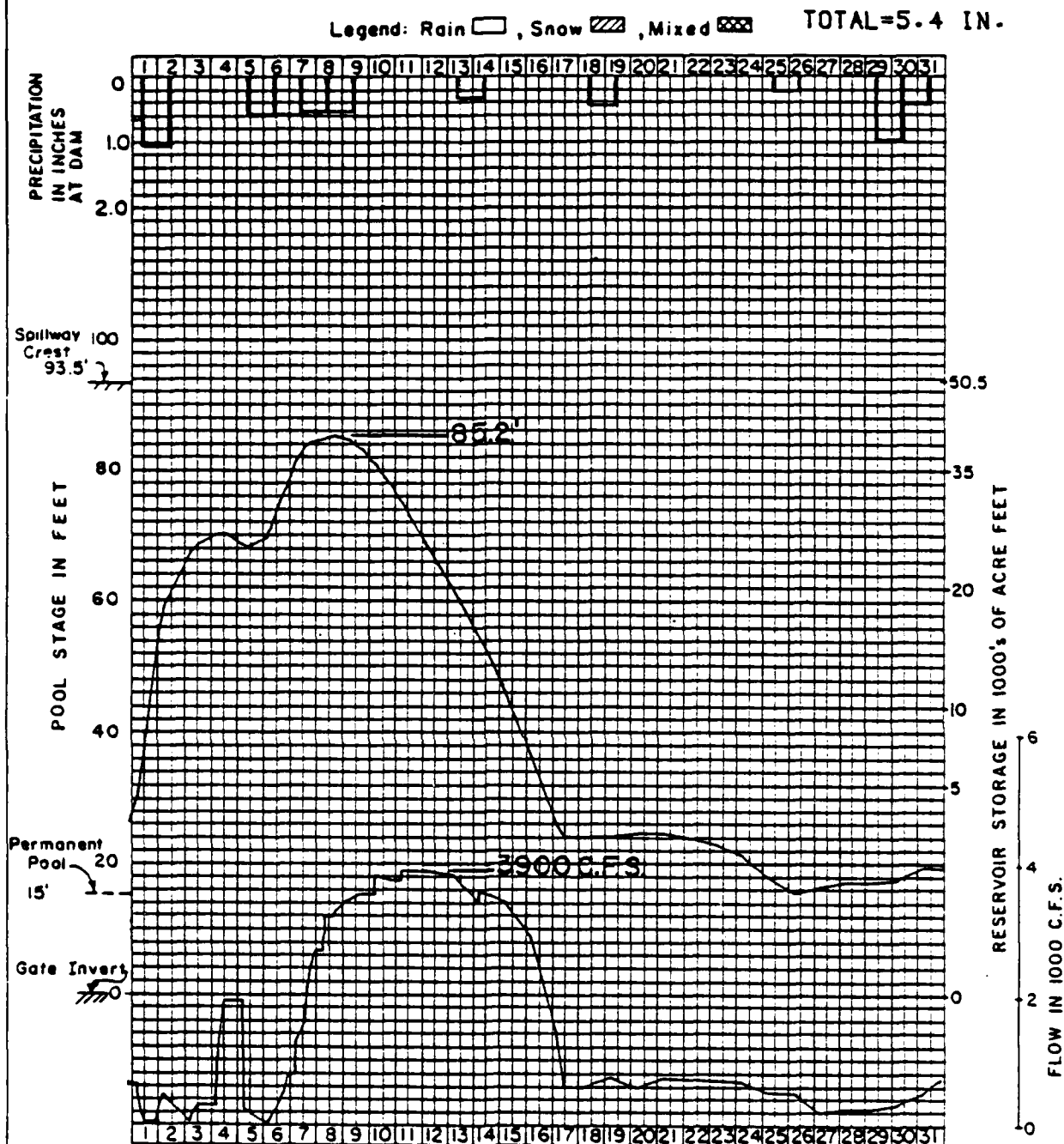
D.A. = 220 SQ. MILES

1" RO = 11,730 Ac Ft

NEW ENGLAND DIVISION

WALTHAM, MASS.

	ELEVATION	STAGE	GROSS STORAGE
	MSL	FEET	AC-FT
Gate Invert	390.0	0	0
Winter Pool	410.0	20.0	700
Summer Pool	425.0	35.0	3050
Spillway Crest	546.5	156.5	71,800
Outlet Capacity at Full Pool = 11,900 c.f.s.			



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MONTHLY RESERVOIR OPERATION

NORTH SPRINGFIELD RESERVOIR
CONNECTICUT RIVER BASIN

D.A. = 158 SQ. MILES

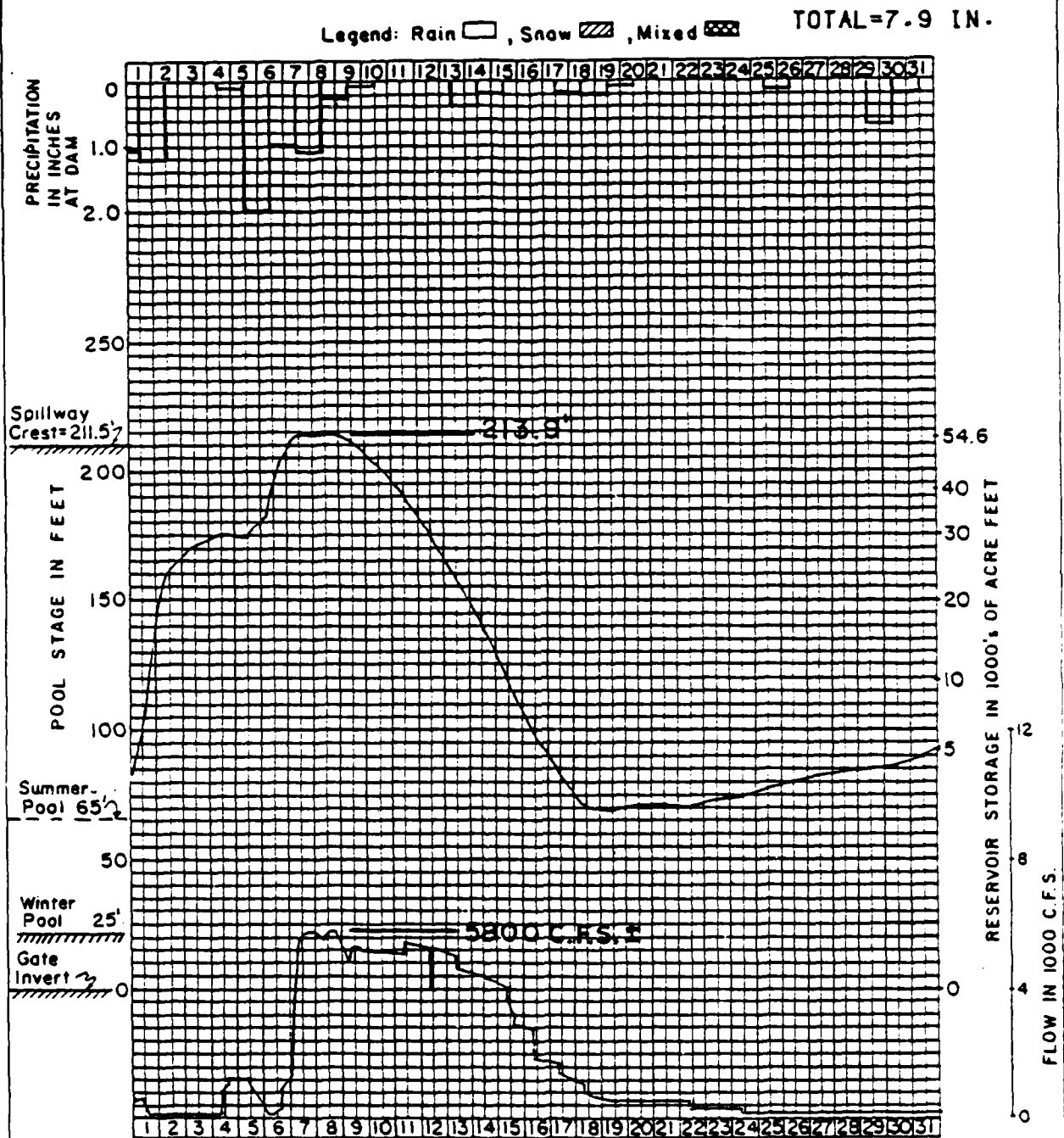
I^{RO} = 8420 Ac-Ft.

NEW ENGLAND DIVISION

WALTHAM, MASS.

	ELEVATION MSL	STAGE FEET	GROSS STORAGE AC-FT
Gate Invert	452.0	0	0
Permanent Pool	467.0	15	500
Spillway Crest	545.5	93.5	50,500

Outlet Capacity at Full Pool = 7650 C.F.S.



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MONTHLY RESERVOIR OPERATION

BALL MOUNTAIN RESERVOIR
CONNECTICUT RIVER BASIN

D.A. = 172 SQ. MILES

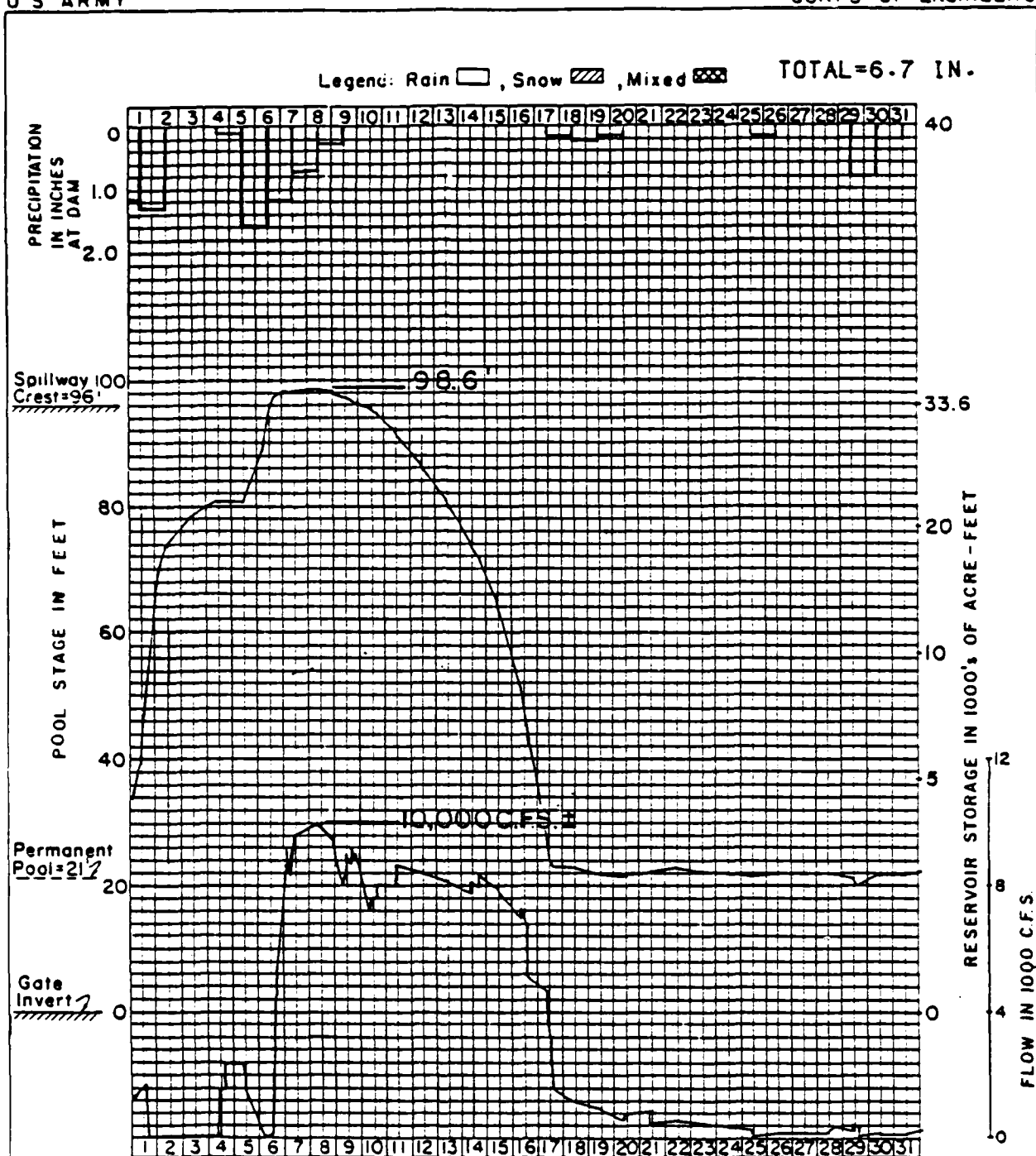
1" R.O. = 9180 Ac. Ft.

NEW ENGLAND DIVISION

WALTHAM, MASS.

ELEVATION	STAGE	GROSS
MSL	FEET	STORAGE
		AC-FT
Gate Invert 805.5	0	0
Permanent Pool 870.5	65	2240
Spillway Crest 1017.0	211.5	54,600

Outlet Capacity at Full Pool = 11,350 c.f.s.



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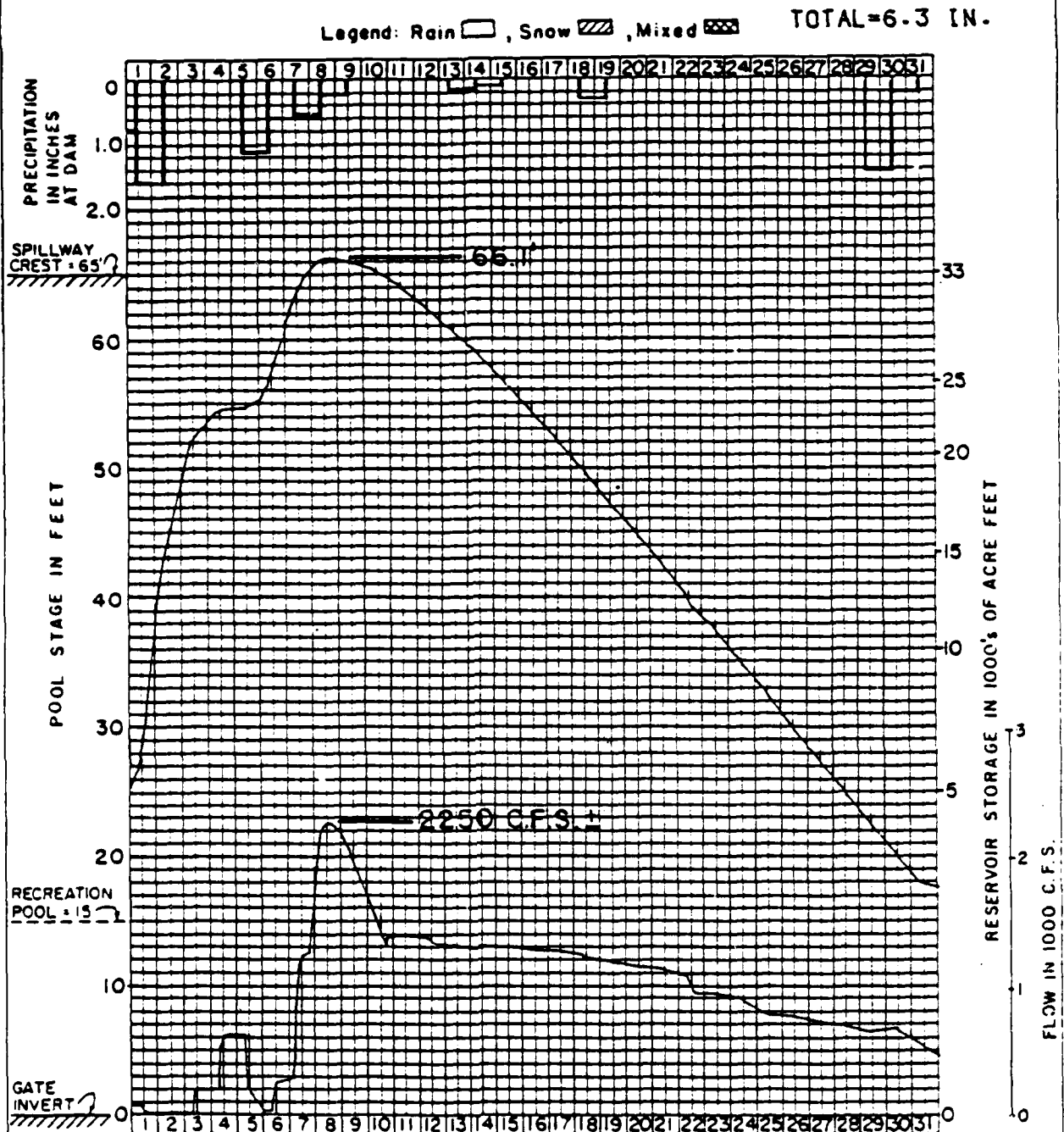
MONTHLY RESERVOIR OPERATION

TOWNSHEND RESERVOIR
CONNECTICUT RIVER BASIN

ELEVATION	STAGE	GROSS STORAGE
MSL	FEET	AC-FT
Gate Invert 457.0	0	0
Permanent Pool 478.0	21.0	800
Spillway Crest 553.0	96.0	33,600

Outlet Capacity at Full Pool = 21,300 c.f.s.

D.A. (Net) 106 SQ. MILES
(Gross) 278
1" R.O. = 5650 Ac-Ft. (Net Area)
NEW ENGLAND DIVISION
WALTHAM, MASS.



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MONTHLY RESERVOIR OPERATION

SURREY MOUNTAIN RESERVOIR

CONNECTICUT RIVER BASIN

ASHUELOT RIVER, N.H.

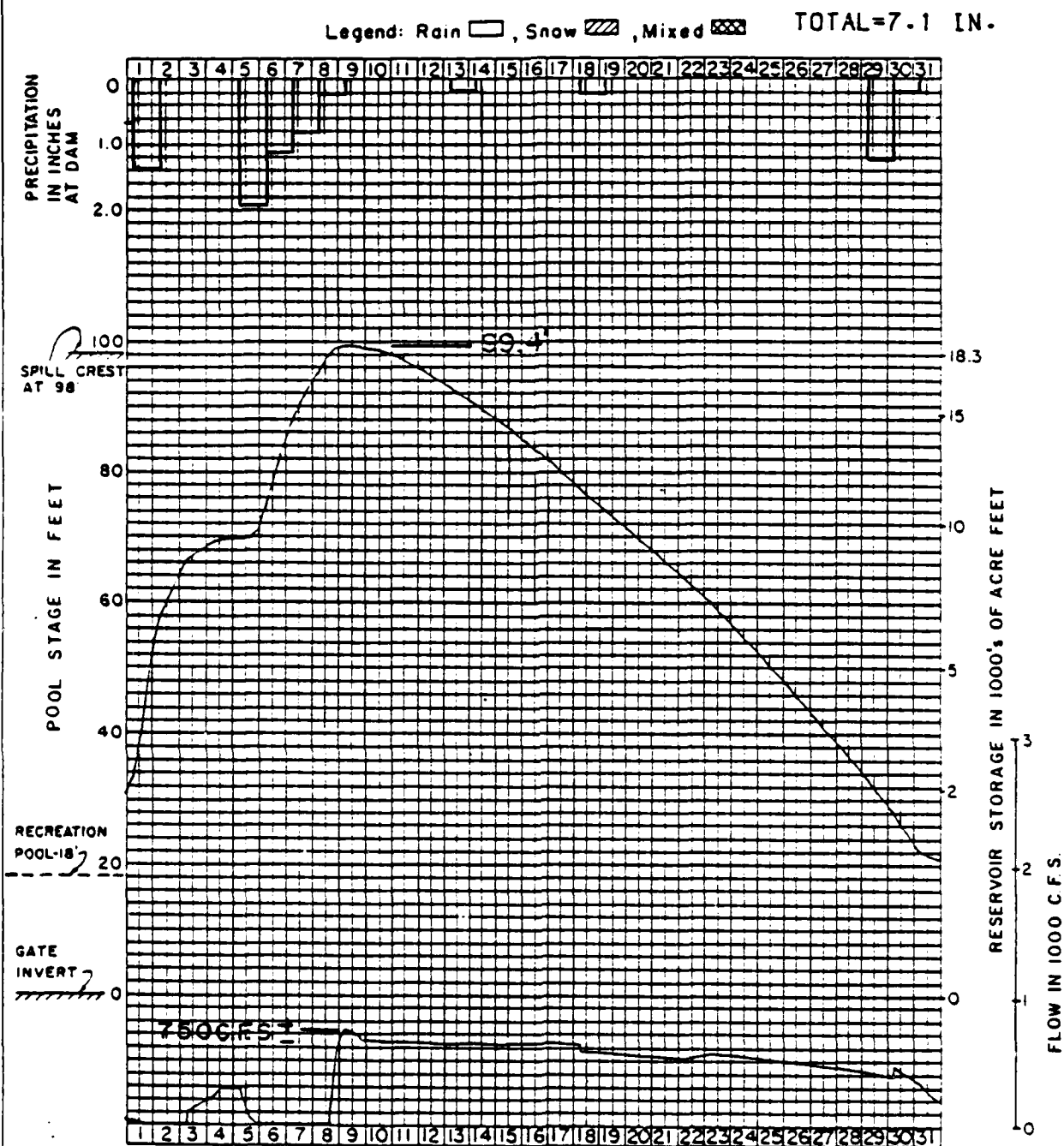
D.A. = 100 SQ. MILES

1" R.O. = 5330 Ac-Ft

	ELEVATION MSL.	STAGE FEET	GROSS STORAGE AC-FT
Gate Invert	485	0	0
Recreation Pool	500	15	1,320
Spillway Crest	550	65	33,000

Outlet Capacity at Full Pool = 3,660 C.F.S.

NEW ENGLAND DIVISION
WALTHAM, MASS.



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MONTHLY RESERVOIR OPERATION

OTTER BROOK RESERVOIR

CONNECTICUT RIVER BASIN

D.A. = 47 SQ. MILES

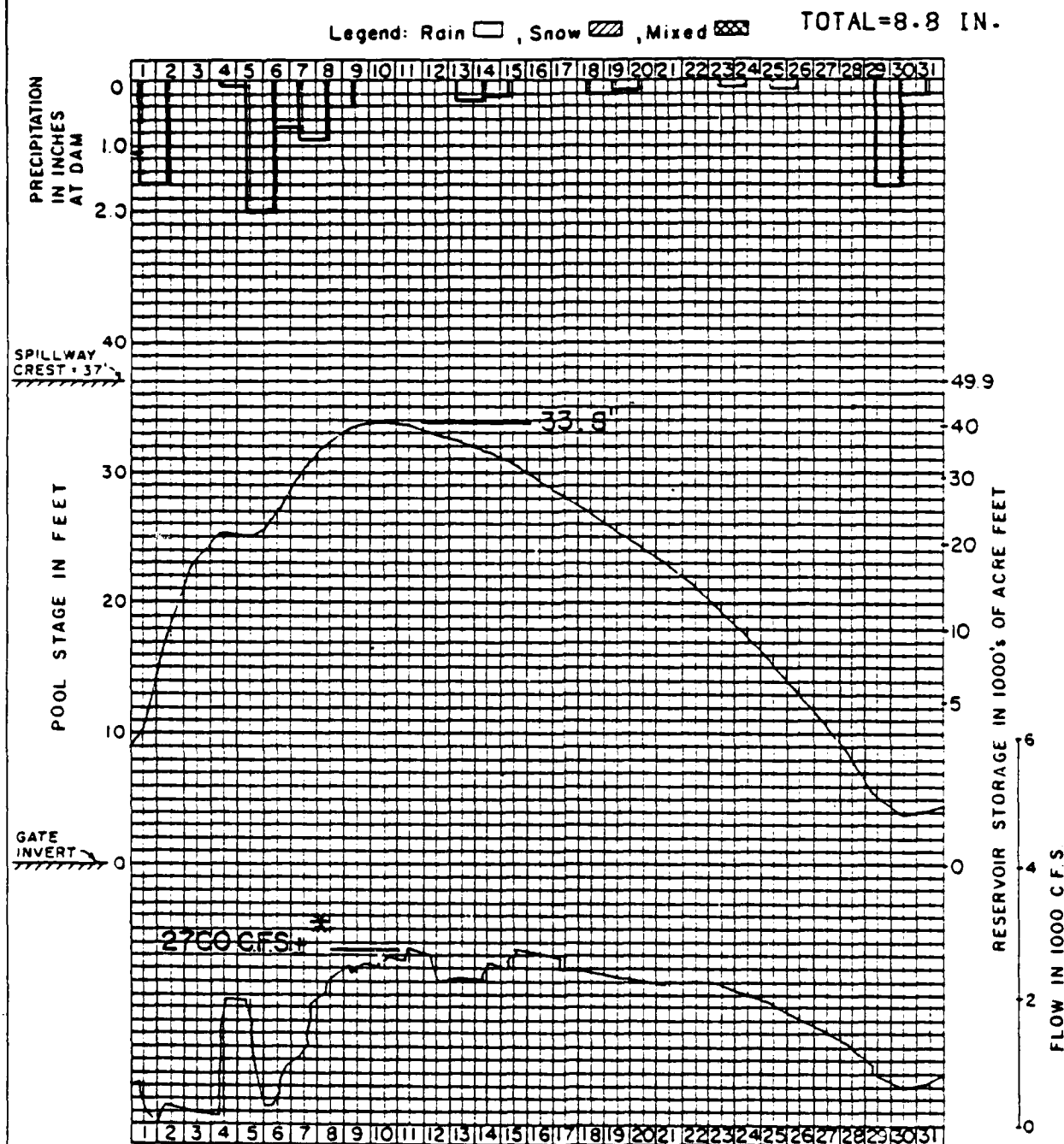
Iⁿ R.O. = 2510 Ac.-Ft.

NEW ENGLAND DIVISION

WALTHAM, MASS.

	ELEVATION	STAGE	GROSS
	MSL	FEET	STORAGE
			AC.-FT
Gate Invert	683	0	0
Recreation Pool	701	18	720
Spillway Crest	781	98	18,320

Outlet Capacity at Full Pool = 1,500 C.F.S.



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MONTHLY RESERVOIR OPERATION

BIRCH HILL RESERVOIR
CONNECTICUT RIVER BASIN

D.A. = 175 SQ. MILES

Ist R.O. = 9325 Ac-Ft

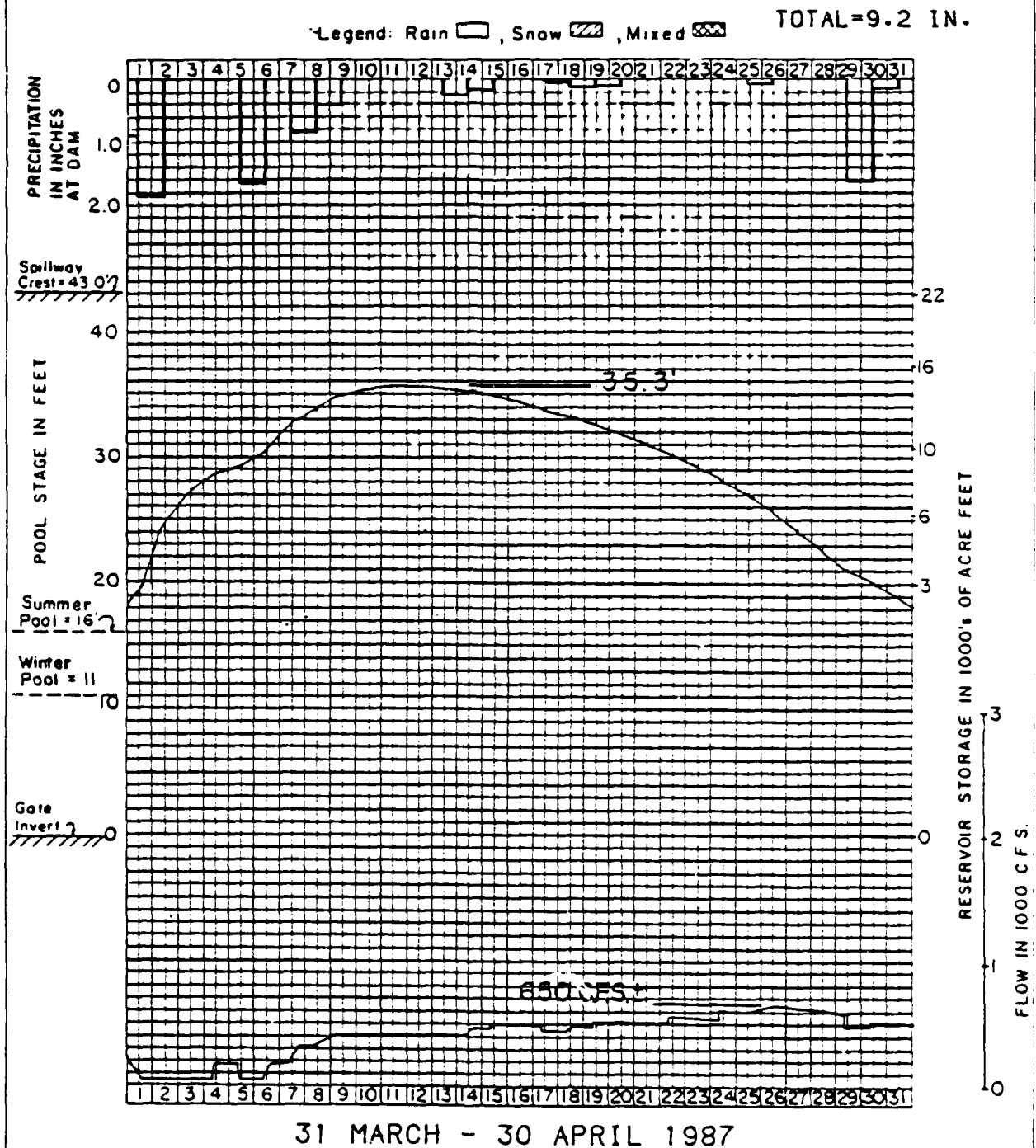
NEW ENGLAND DIVISION

WALTHAM, MASS.

	ELEVATION	STAGE	GROSS
	MSL.	FEET	STORAGE
			AC-FT
Gate Invert	815	0	0
Permanent Pool	NONE	—	—
Spillway Crest	852	37	49,900

Outlet Capacity at Full Pool = 10,500 C.F.S.

* DISCHARGE AT SOUTH ROYALSTON GAGE



MONTHLY RESERVOIR OPERATION

TULLY RESERVOIR
CONNECTICUT RIVER BASIN

D.A. = 50 SQ. MILES

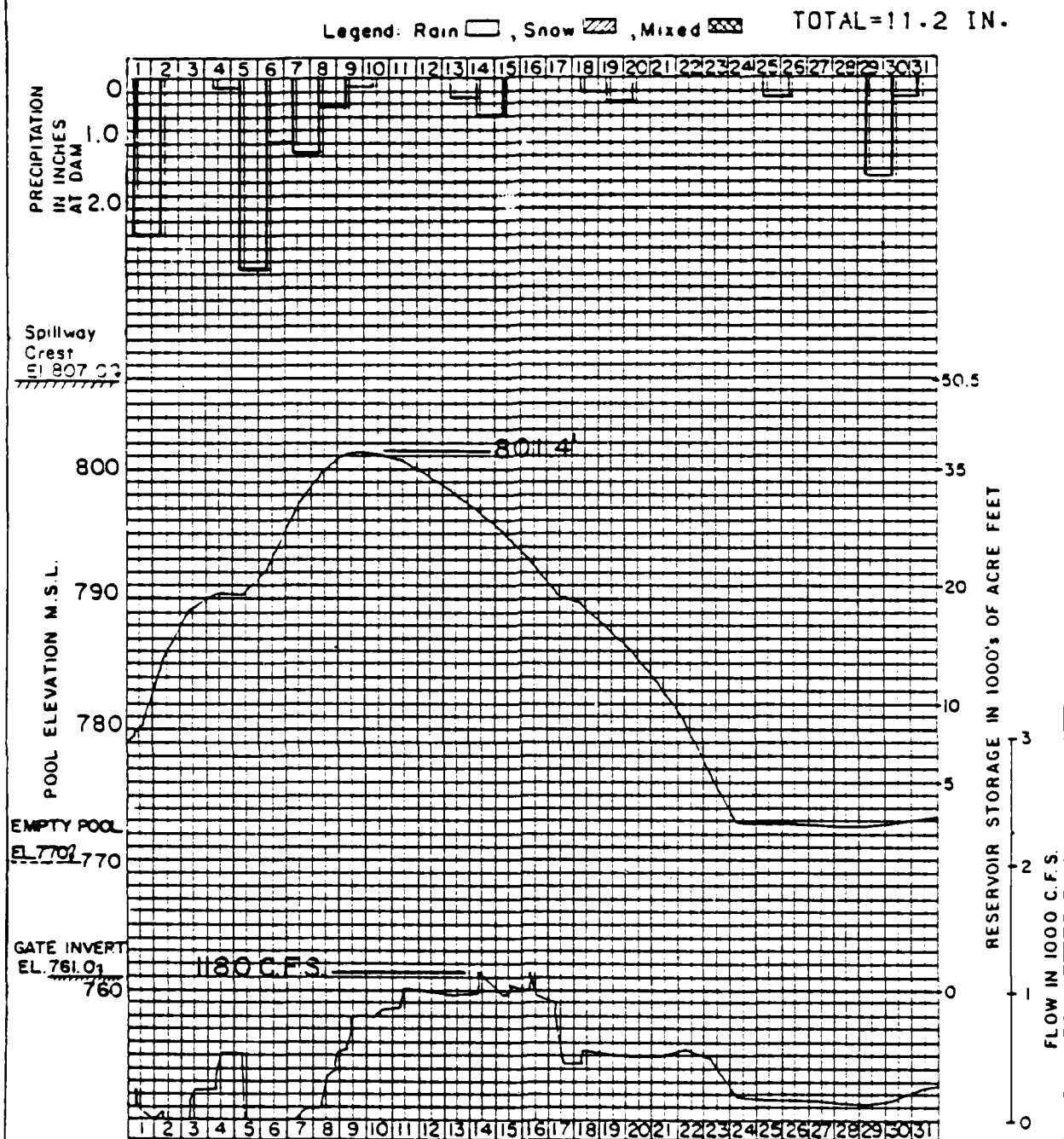
1" R.O. = 2660 Ac - Ft

NEW ENGLAND DIVISION

WALTHAM, MASS.

	ELEVATION MSL	STAGE FEET	GROSS STORAGE AC-FT
Gate Invert	625.0	0	0
Recreation Pool	641.0	16	1500
Spillway Crest	668.0	43	22,000

Outlet Capacity at Full Pool = 1,030 c.f.s.

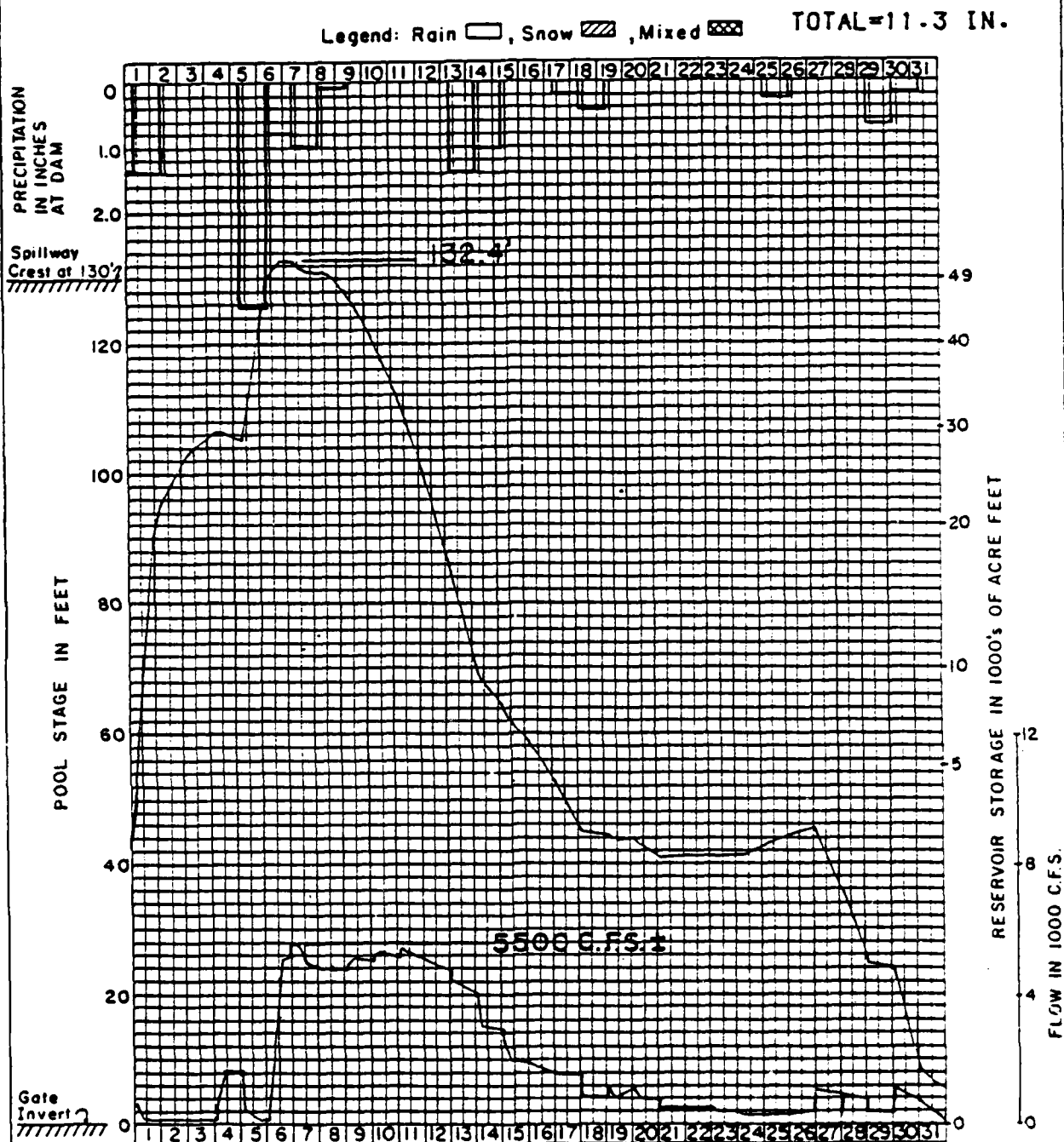


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MONTHLY RESERVOIR OPERATION

	ELEVATION	GROSS STORAGE Ac Ft
Gate Invert	761.0	—
Permanent Pool	NONE	—
Full Pool	807.0	24,000
Outlet Capacity at Full Pool 3,000 c.f.s.		

BARRE FALLS RESERVOIR
CONNECTICUT RIVER BASIN
D.A. 55 SQ. MILES
1" R.O. = 2930 Ac Ft
NEW ENGLAND DIVISION
WALTHAM, MASS.



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MONTHLY RESERVOIR OPERATION

KNIGHTVILLE RESERVOIR

WESTFIELD RIVER BASIN

D.A. = 162 SQ. MILES

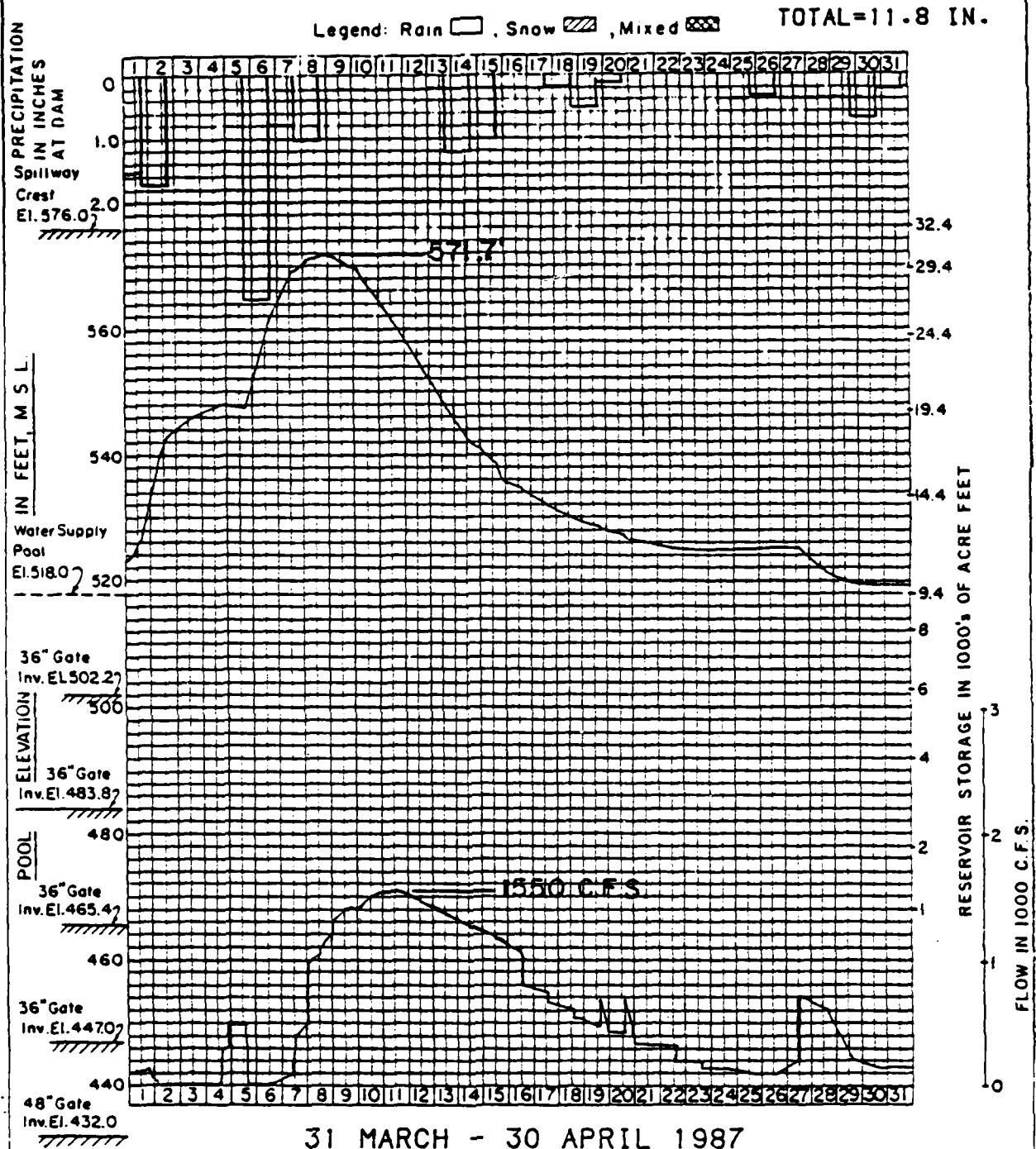
1" R.O. = 8630 Ac.-Ft.

NEW ENGLAND DIVISION

WALTHAM, MASS.

	ELEVATION MSL	STAGE FEET	NET STORAGE AC.-FT
Gate Invert	480	0	0
Permanent Pool	NONE	—	—
Spillway Crest	610	130	49,000

Outlet Capacity at Full Pool = 15,000 C.F.S.



MONTHLY RESERVOIR OPERATION

LITTLEVILLE RESERVOIR
CONNECTICUT RIVER BASIN

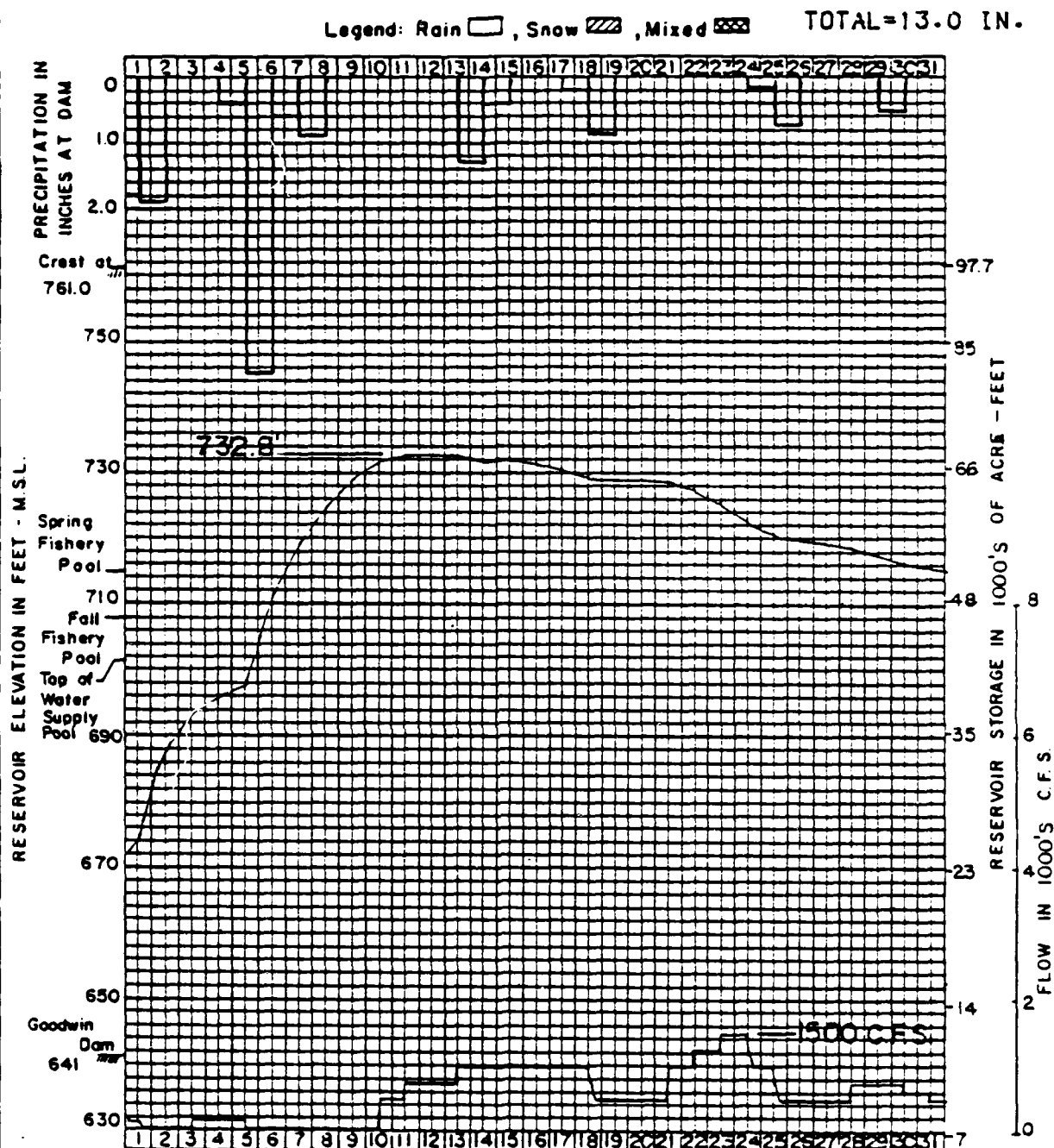
D.A. = 52.3 SQ. MILES

1" R.O. = 2790 Ac-Ft

NEW ENGLAND DIVISION
WALTHAM, MASS.

	ELEVATION MSL	STORAGE	
		WATER SUPPLY AC-FT.	FLOOD CONTROL AC-FT.
Gate Invert	432.0	0	—
Permanent Pool	518.0	9400	0
Spillway Crest	576.0	—	23,000

Flood Control Outlet Capacity at Full Pool = 2175 C.F.S.



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MONTHLY RESERVOIR OPERATION

COLEBROOK RIVER RESERVOIR

CONNECTICUT RIVER BASIN

D.A. = 118 SQ. MILES

Ist R.O. = 6290 Ac - Ft.

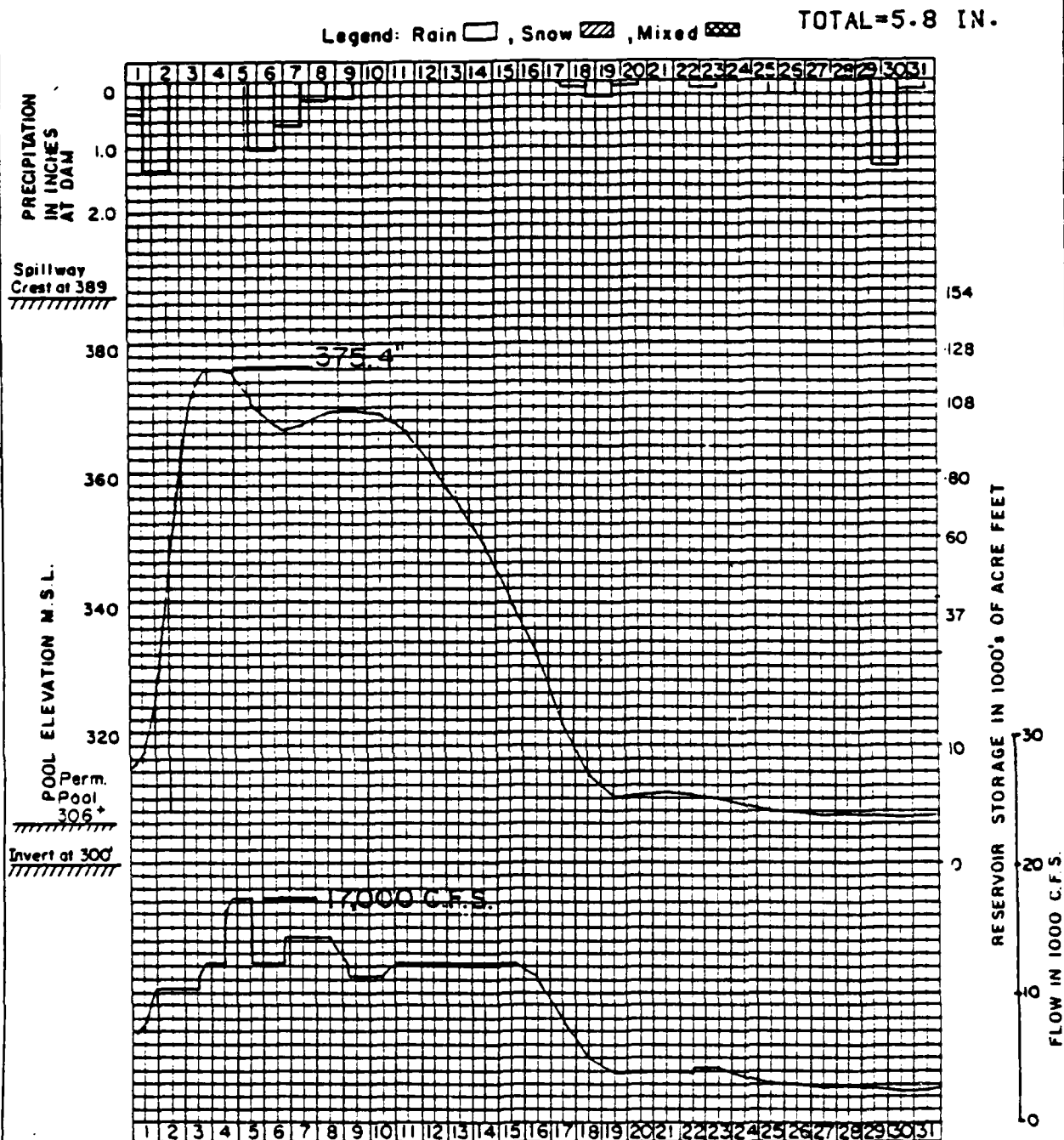
NEW ENGLAND DIVISION

WALTHAM, MASS.

	ELEVATION		STORAGE (Ac-Ft)			
	(msl)	W.S.	F.C.	FISH	OTHER	TOTAL
Invert	575	-	-	-	-	-
Top of W.S.	701.2	41,500	0	0	1,000	42,500
Top of F.F.	708	0	0	5,000	0	47,500
Top of S.F.	714.5	0	0	5,000*	0	52,500
Top of F.C.	761	0	50,200	0	0	97,700

* Temporary infringement upon flood control storage between April and 1st July.

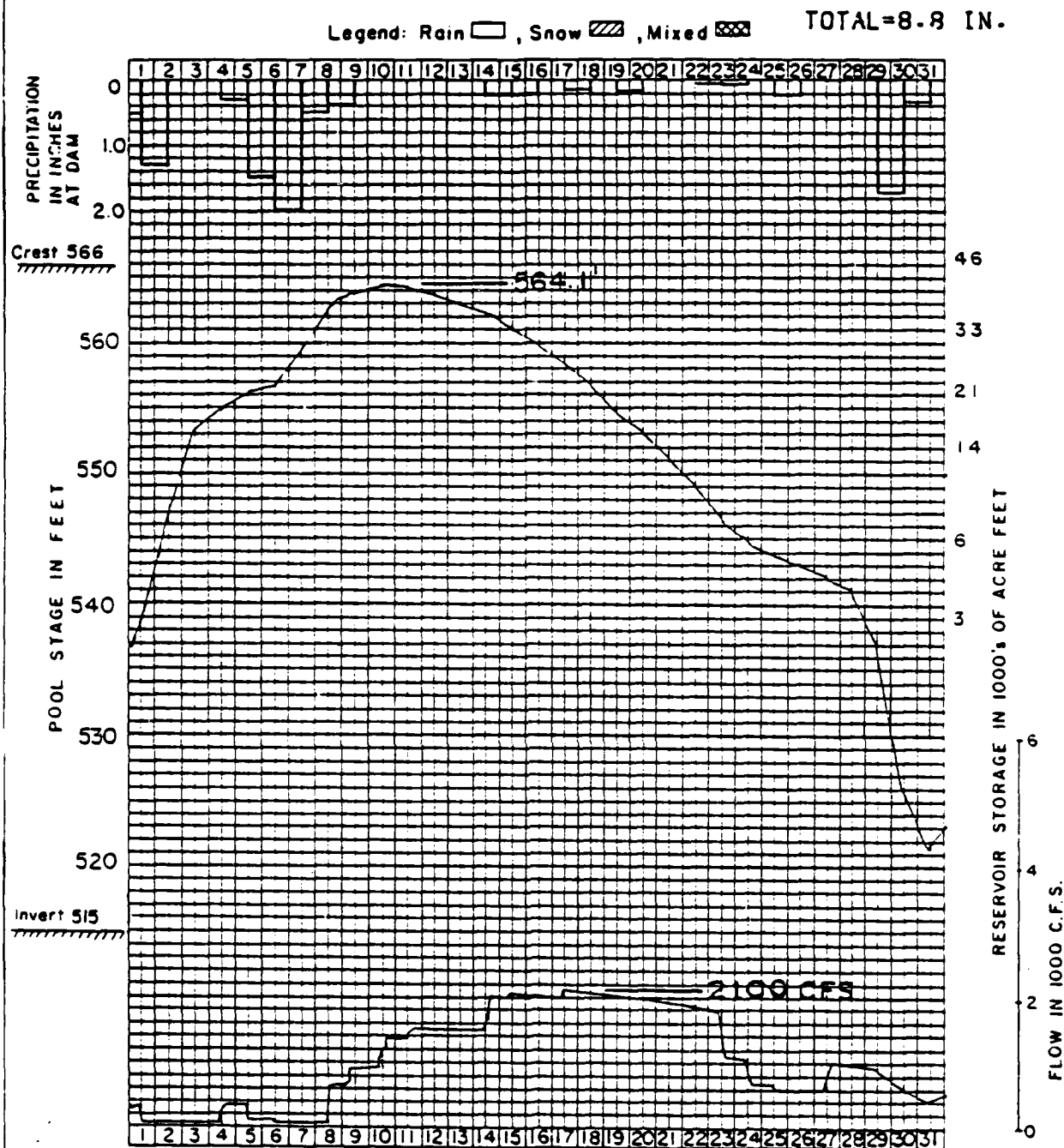
Flood Control Outlet Capacity at Full Pool = 4,500 CFS



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MONTHLY RESERVOIR OPERATION

		FRANKLIN FALLS RESERVOIR	
		PEMIGEWASSET RIVER BASIN	
		D.A. 1000 SQ. MILES	
		1" R.O. = 53,300 Ac Ft	
		NEW ENGLAND DIVISION	
		WALTHAM, MASS.	
	ELEVATION	GROSS STORAGE Ac. Ft.	
Gate Invert	300	Ac. Ft.	
Normal Pool	307.5	3000	
Pool at Spillway Crest	389.0	154000	
Outlet Capacity with Pool at Spillway Crest	= 42,000 c.f.s.		
Maximum Regulated Outlet Discharge	= 18,000 c.f.s.		

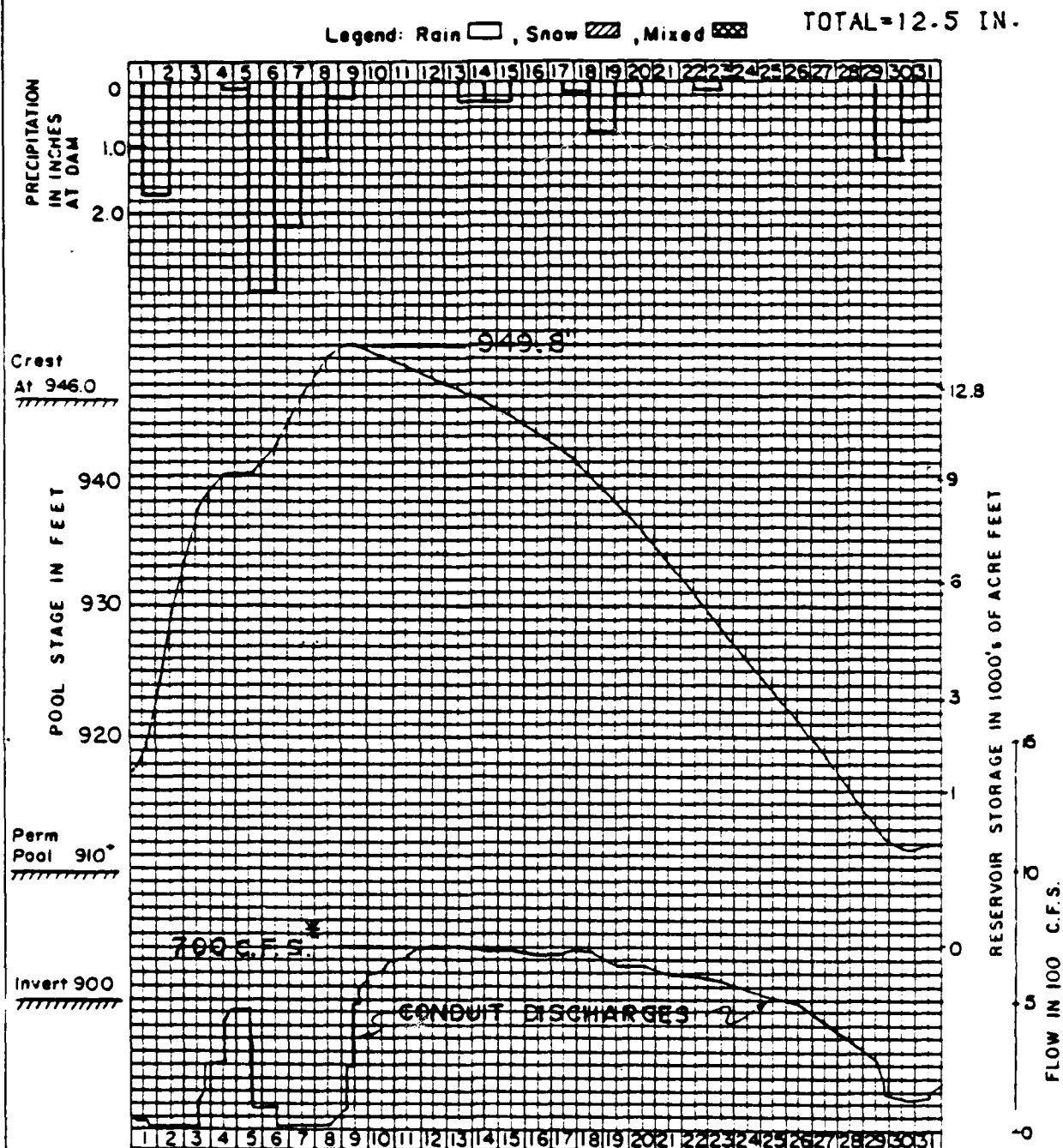


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MONTHLY RESERVOIR OPERATION

	ELEVATION	GROSS STORAGE Ac. Ft.
Gate Invert	515	0
Full Pool	566.0	46000
Outlet Capacity at Full Pool 3700 c.f.s.		

BLACKWATER	RESERVOIR
MERRIMACK	RIVER BASIN
D.A. = 128	SQ. MILES
I ^r R.O. = 6825 Ac-Ft	
NEW ENGLAND DIVISION	
WALTHAM, MASS.	



31 MARCH - 30 APRIL 1987

	ELEVATION	GROSS STORAGE (Ac.-Ft.)
Gate Invert	904.0	0
Normal Pool	911.2	200±
Full Pool	946.0	12,800 Ac. Ft.

Outlet Capacity at Full Pool 1760 c.f.s.

MONTHLY RESERVOIR OPERATION

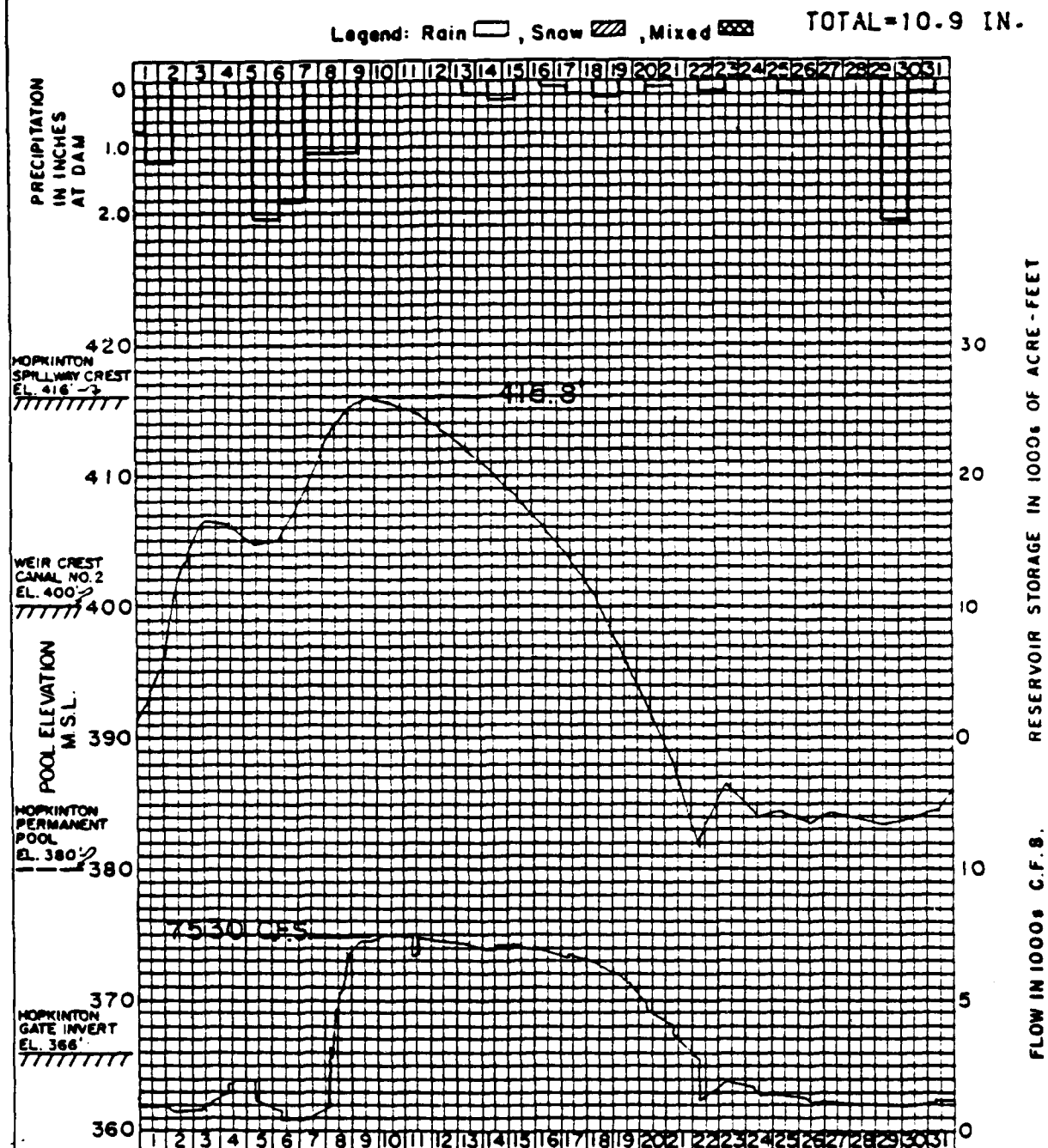
EDWARD MACDOWELL RESERVOIR
MERRIMACK RIVER BASIN

D.A. 4.4 SQ. MILES

1" R.O. = 2350 Ac.-Ft.

NEW ENGLAND DIVISION
WALTHAM, MASS.

* DOES NOT INCLUDE SPILLWAY DISCHARGE WHICH HAD AN ESTIMATED PEAK OF 800 CFS ON 8 APRIL. FLOWS AFFECTED BY SARGENT CAMP ROAD IN UPPER END OF RESERVOIR.



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MONTHLY RESERVOIR OPERATION

HOPKINTON - EVERETT RESERVOIR

MERRIMACK RIVER BASIN

HOPKINTON RESERVOIR

CONTOOCOOK RIVER, N.H.

D.A. (NET) 382 SQ. MILES

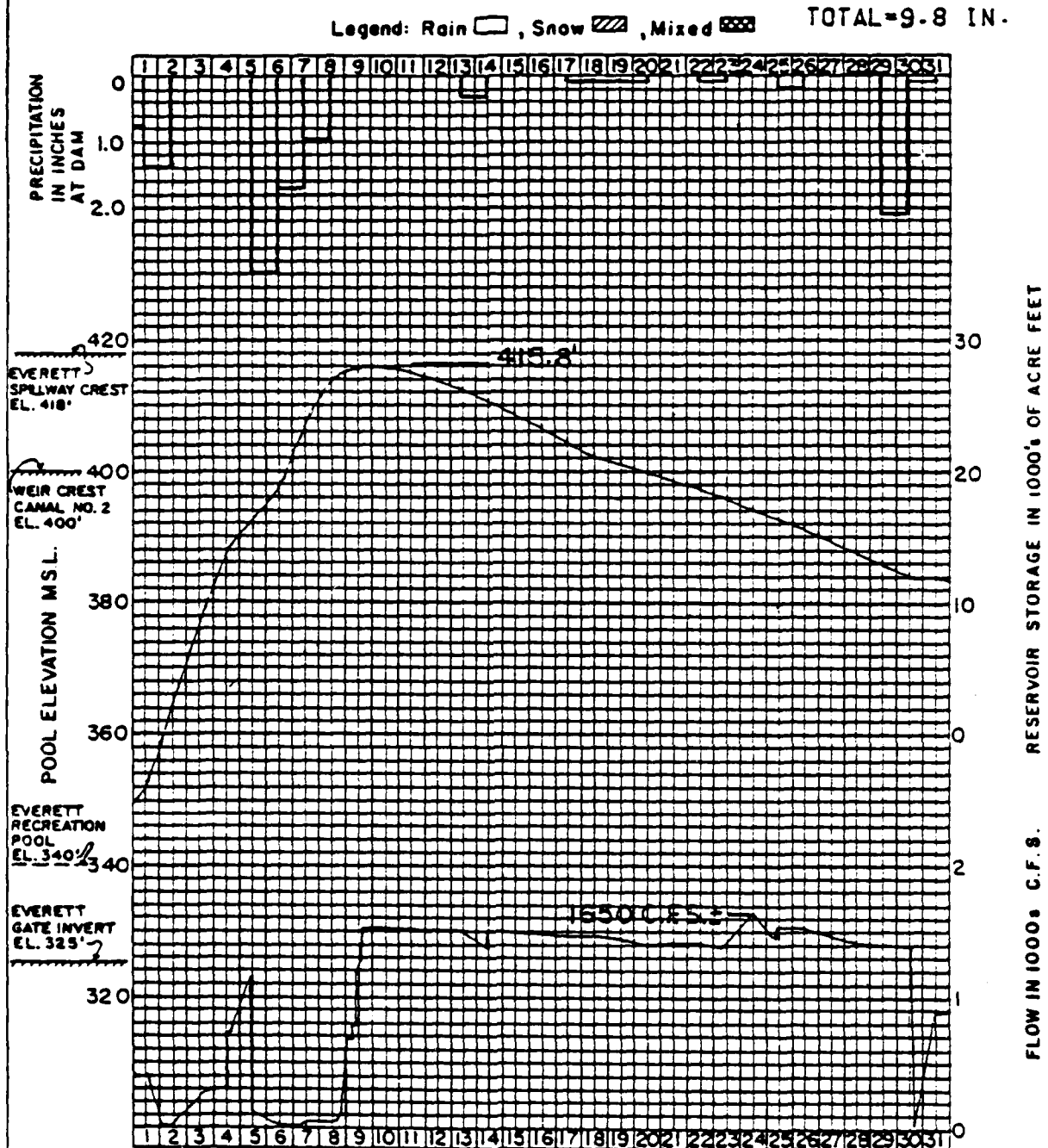
(GROSS) 426 SQ. MILES

I.R.O. = 20,350 Ac Ft. (NET AREA)

NEW ENGLAND DIVISION
WALTHAM, MASS.

GROSS STORAGE IN ACRE FEET

	Hopkinton Reservoir	Everett Reservoir	Hopkinton - Everett Reservoir
GATE INVERT	0	0	0
PERMANENT POOL	700	1,000	1,700
WEIR CREST - CANAL NO. 2	23,500	48,500	72,000
SPILLWAY CREST (HOPKINTON)	70,800	86,500	157,300
HOPKINTON OUTLET CAPACITY (POOL AT ELEV. 416) = 14,000 C.F.S.			
EVERETT OUTLET CAPACITY (POOL AT ELEV. 416) = 3,000 C.F.S.			
157,300 Ac-Ft. = 6.0" from 490 sq. mi.			
6.6" from 446 sq. mi.			



MONTHLY RESERVOIR OPERATION

HOPKINTON - EVERETT RESERVOIR

MERRIMACK RIVER BASIN

EVERETT RESERVOIR

PISCATAQUOG RIVER, N.H.

D.A. = 64 SQ. MILES

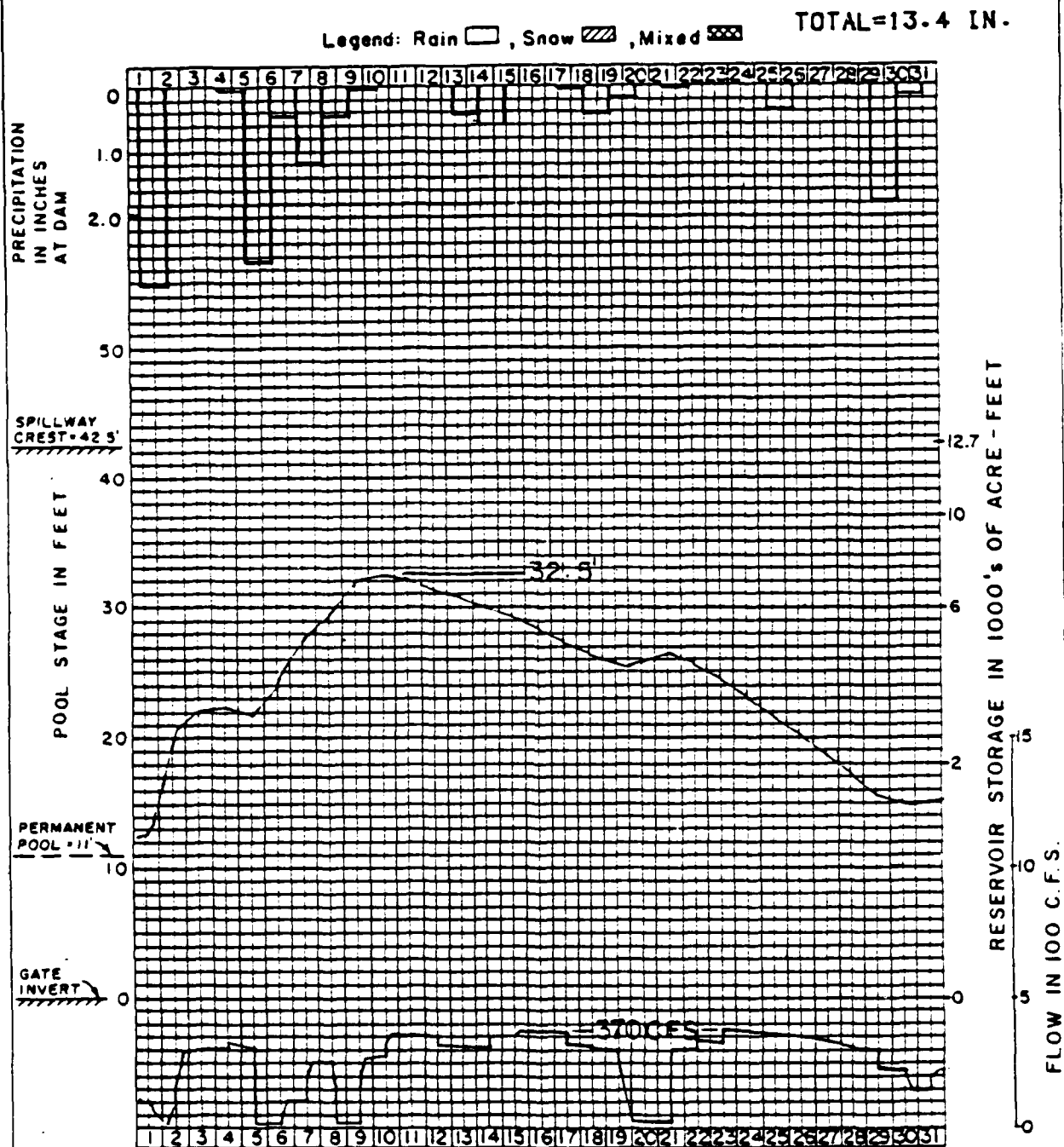
1" R.O. = 3410 Ac.-Ft. (Net Area)

NEW ENGLAND DIVISION
WALTHAM, MASS.

GROSS STORAGE IN ACRE FEET

	Hopkinton Reservoir	Everett Reservoir	Hopkinton - Everett Reservoir
GATE INVERT	0	0	0
PERMANENT POOL	700	1,000	1,700
WEIR CREST - CANAL NO. 2	23,500	48,500	72,000
SPILLWAY CREST (HOPKINTON)	70,800	86,500	157,300
HOPKINTON OUTLET CAPACITY (POOL AT ELEV. 416)	14,000 C.F.S.		
EVERETT OUTLET CAPACITY (POOL AT ELEV. 416)	3,000 C.F.S.		

157,300 Ac.-Ft. = 8.0" from 490 sq. mi.
6.6" from 446 sq. mi.



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MONTHLY RESERVOIR OPERATION

BUFFUMVILLE RESERVOIR

THAMES RIVER BASIN

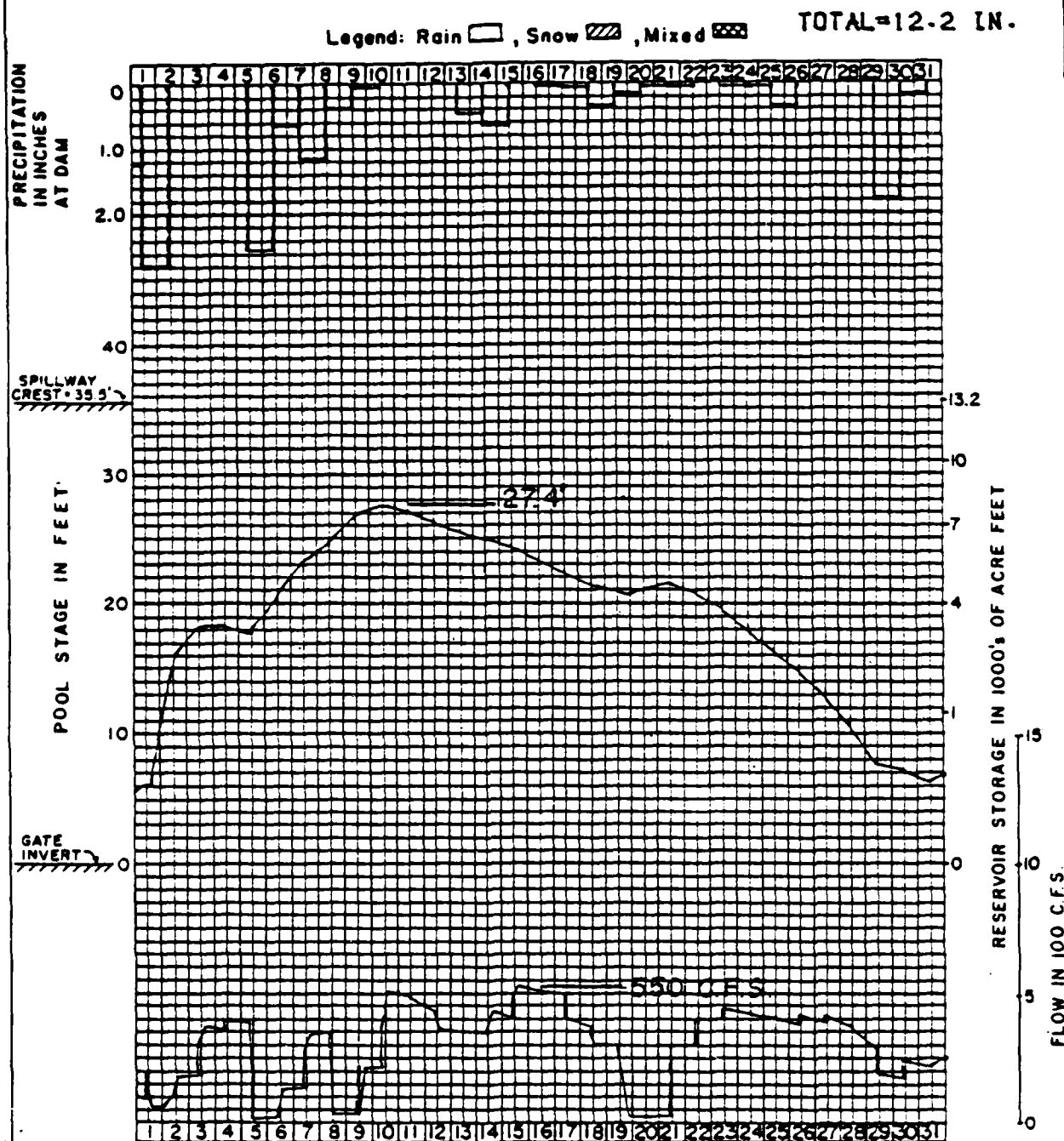
D.A. = 26.5 SQ. MILES

1" R.O. = 1410 Ac.-FT.

NEW ENGLAND DIVISION

WALTHAM, MASS.

	ELEVATION MSL.	STAGE FEET	GROSS STORAGE AC.-FT.
Gate Invert	481.5	0	0
Permanent Pool	492.5	11.0	1400
Spillway Crest	524.0	42.5	12,700
Outlet Capacity at Full Pool = 1,800 C.F.S.			



MONTHLY RESERVOIR OPERATION

HODGES VILLAGE RESERVOIR
THAMES RIVER BASIN

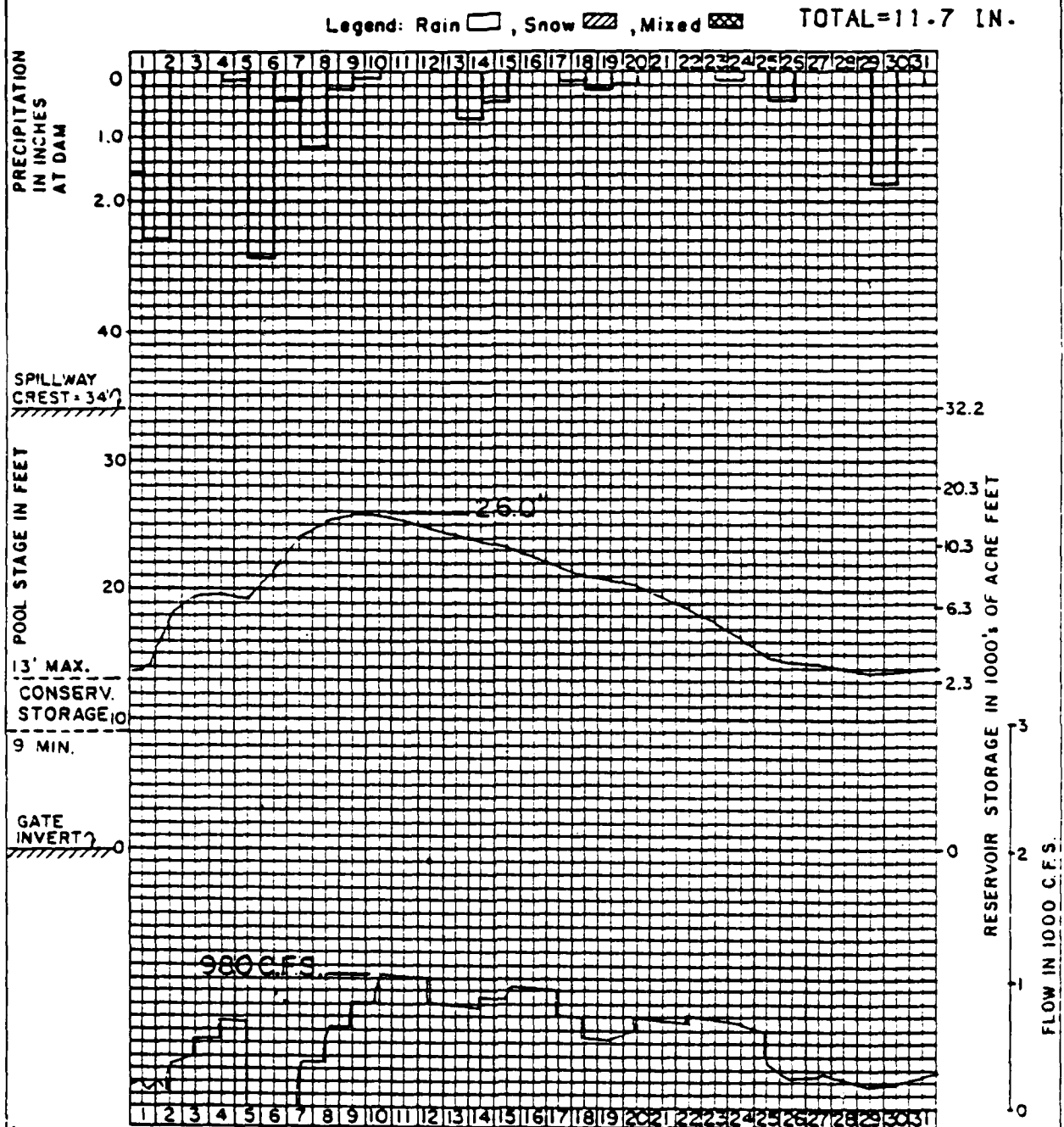
D.A. = 31.1 50. MILES

Ist R.O. = 1660 Ac - Ft.

NEW ENGLAND DIVISION
 WALTHAM, MASS.

	ELEVATION	STAGE	GROSS
	MSL.	FEET	STORAGE
			AC-FT
Gate Invert	465.5	0	0
Permanent Pool	NONE	—	—
Spillway Crest	501.0	35.5	13,250

Outlet Capacity at Full Pool = 1750 cfs.



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MONTHLY RESERVOIR OPERATION

EAST BRIMFIELD RESERVOIR

THAMES RIVER BASIN

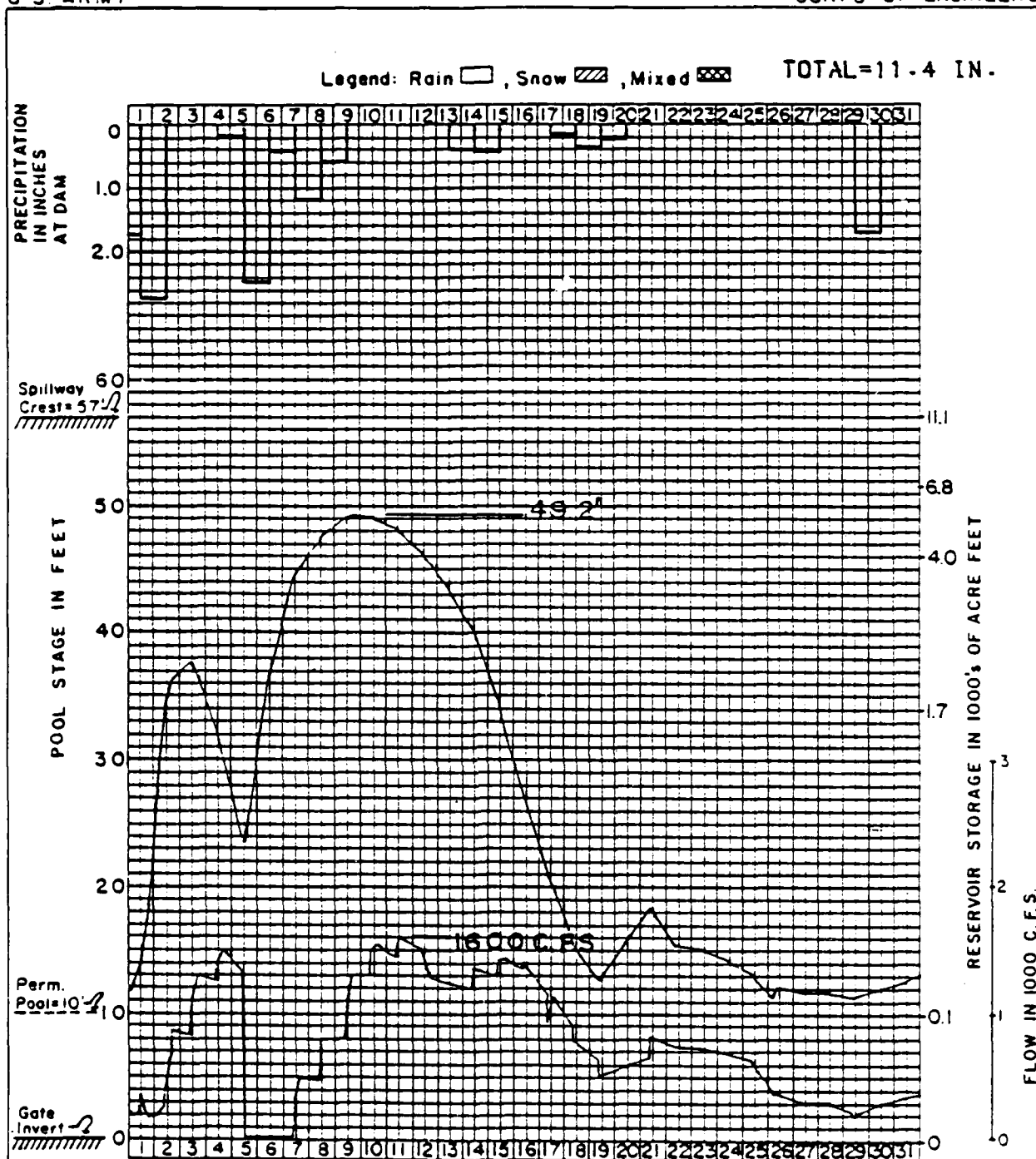
QUINEBAUG RIVER, MASS.

D.A. = 67.5 SQ. MILES

1" R.O. = 3600 Ac - Ft

	ELEVATION (M.S.L.)	STAGE (FEET)	GROSS STORAGE (AC-FT)
Gate Invert	619	0	0
Conservation Pool (Min.)	628	9	1130
Conservation Pool (Max.)	632	13	2320
Spillway Crest	653	34	32200
Outlet Capacity at Full Pool = 3,300 C.F.S.			

NEW ENGLAND DIVISION
WALTHAM, MASS.



31 MARCH - 30 APRIL 1987

MONTHLY RESERVOIR OPERATION

WESTVILLE RESERVOIR

THAMES RIVER BASIN

QUINEBAUG RIVER, MASSACHUSETTS

ELEVATION
(MSL.)STAGE
(FEET)GROSS
STORAGE
(AC-FT)

D.A. = (Net) 32.0 SQ. MILES

(Gross) 99.5 SQ. MILES

1st R.O. = 1,710 Ac - Ft. (Net Area)

Gate Invert

515

0

0

Recreation Pool

525

10

100

Spillway Crest

572

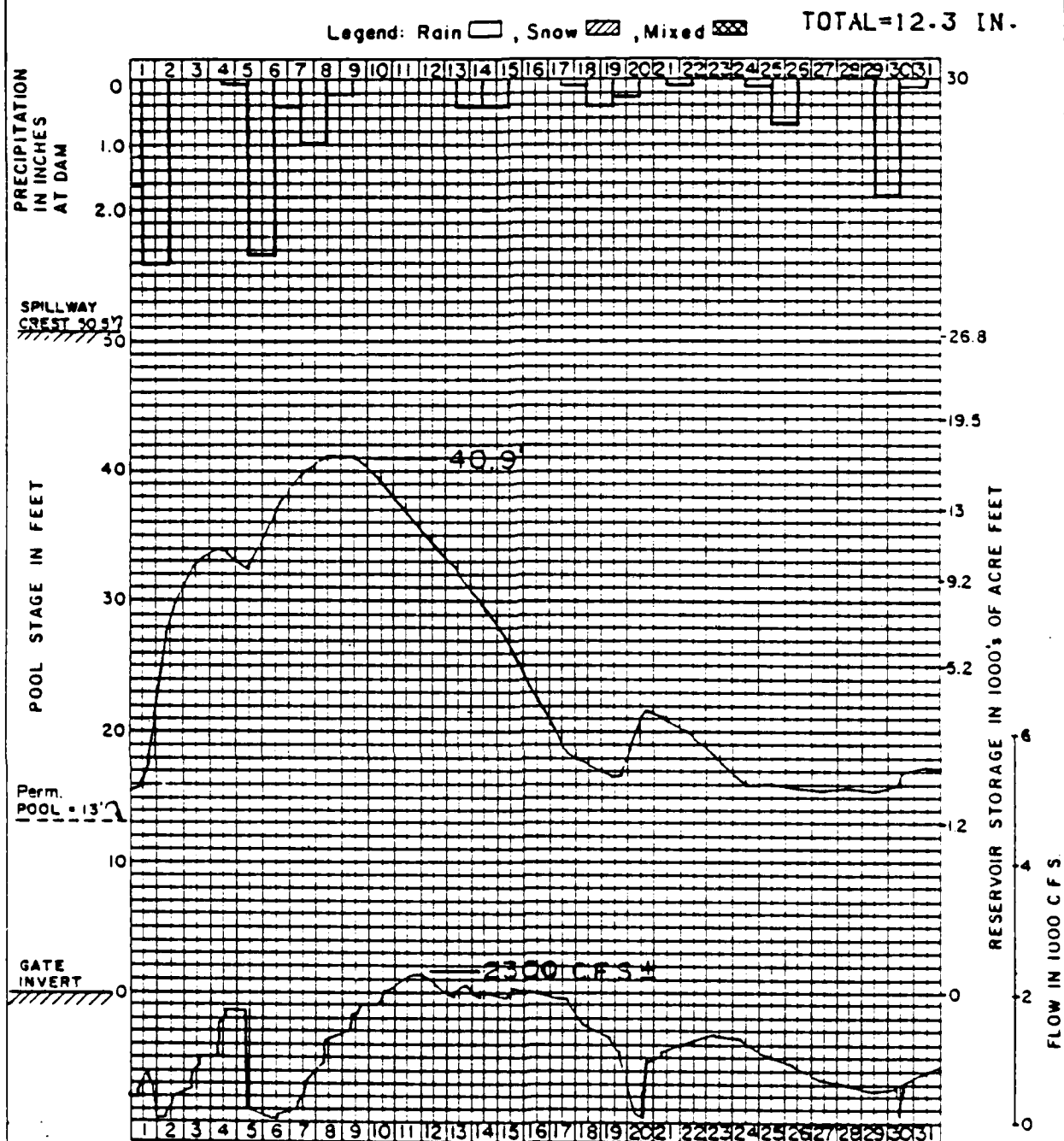
57

11,100

Outlet Capacity at Full Pool = 3,750 C.F.S.

NEW ENGLAND DIVISION

WALTHAM, MASS.



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MONTHLY RESERVOIR OPERATION

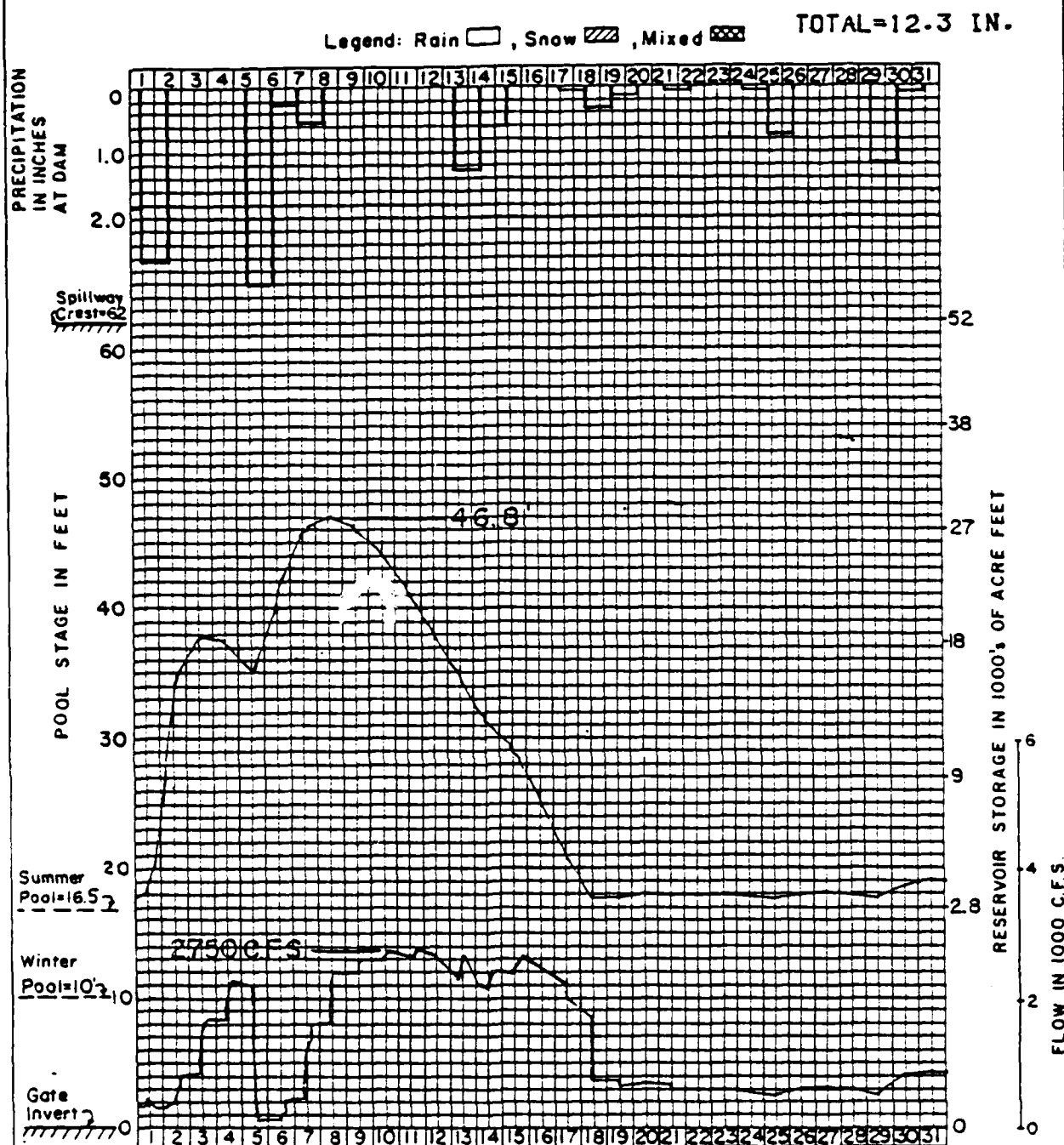
WEST THOMPSON RESERVOIR

THAMES RIVER BASIN

	ELEVATION MSL.	STAGE FEET	GROSS STORAGE AC-FT
Gate Invert	292	0	0
Recreation Pool	305	13	1,200
Spillway Crest	342.5	50.5	26,800

Outlet Capacity at Full Pool = 5,100 C.F.S.

D.A. = (Net) 74 Sq. Miles
 (Gross) 174 Sq. Miles
 Ist R.O. = 3940 Ac-Ft. (Net Area)
 NEW ENGLAND DIVISION
 WALTHAM, MASS.



31 MARCH - 30 APRIL 1987

MONTHLY RESERVOIR OPERATION

MANSFIELD HOLLOW RESERVOIR

THAMES RIVER BASIN

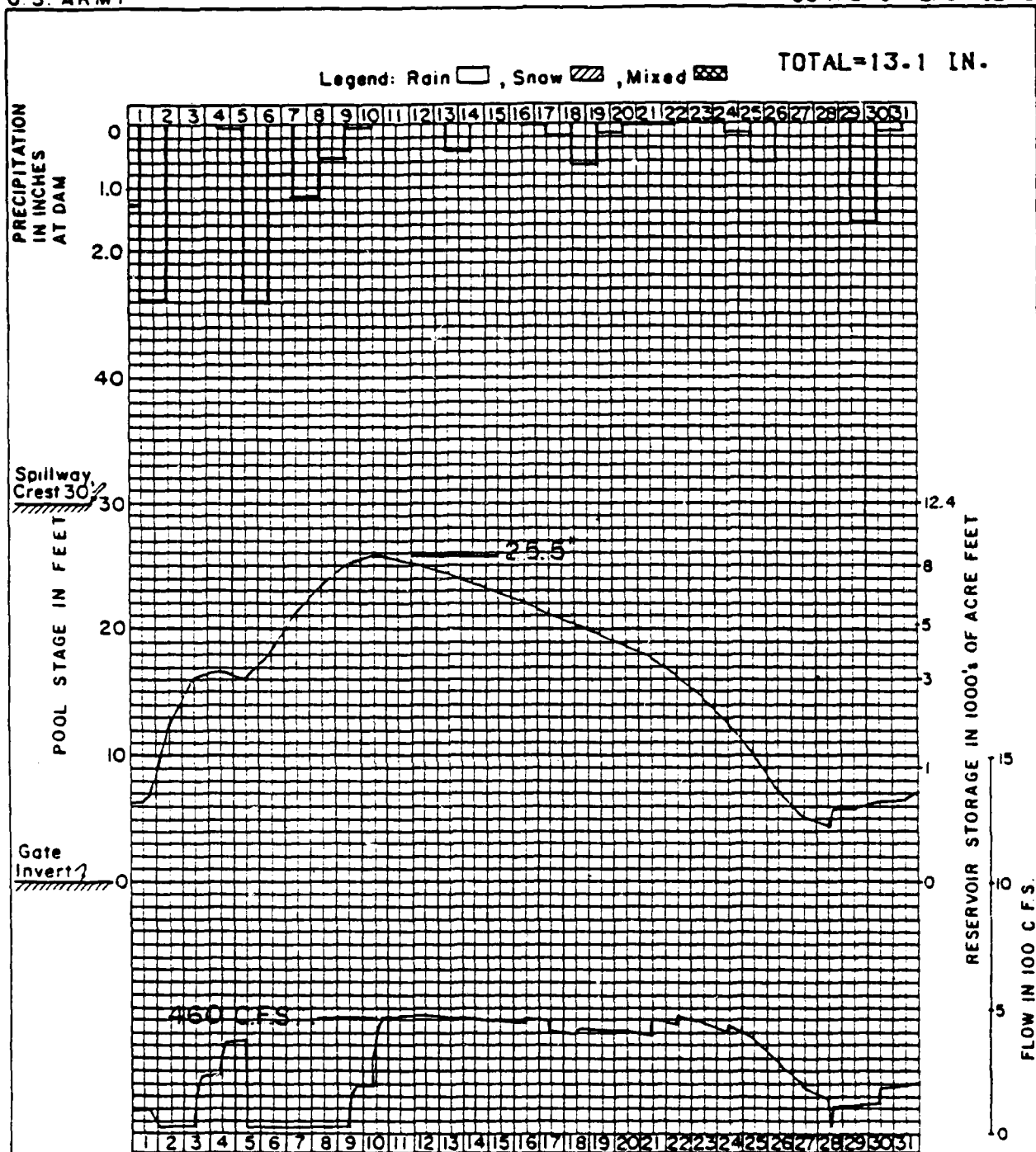
D.A. = 159 SQ. MILES

Ist R.O. = 8480 Ac - Ft

NEW ENGLAND DIVISION

WALTHAM, MASS.

	ELEVATION MSL.	STAGE FEET	GROSS STORAGE AC - FT
Gate Invert	195.0	0	0
Recreation Pool:			
Minimum	205.0	10.0	580
Summer	211.5	16.5	2,800
Spillway Crest	257.0	62.0	52,000
Outlet Capacity at Full Pool	10,200 cfs.		



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MONTHLY RESERVOIR OPERATION

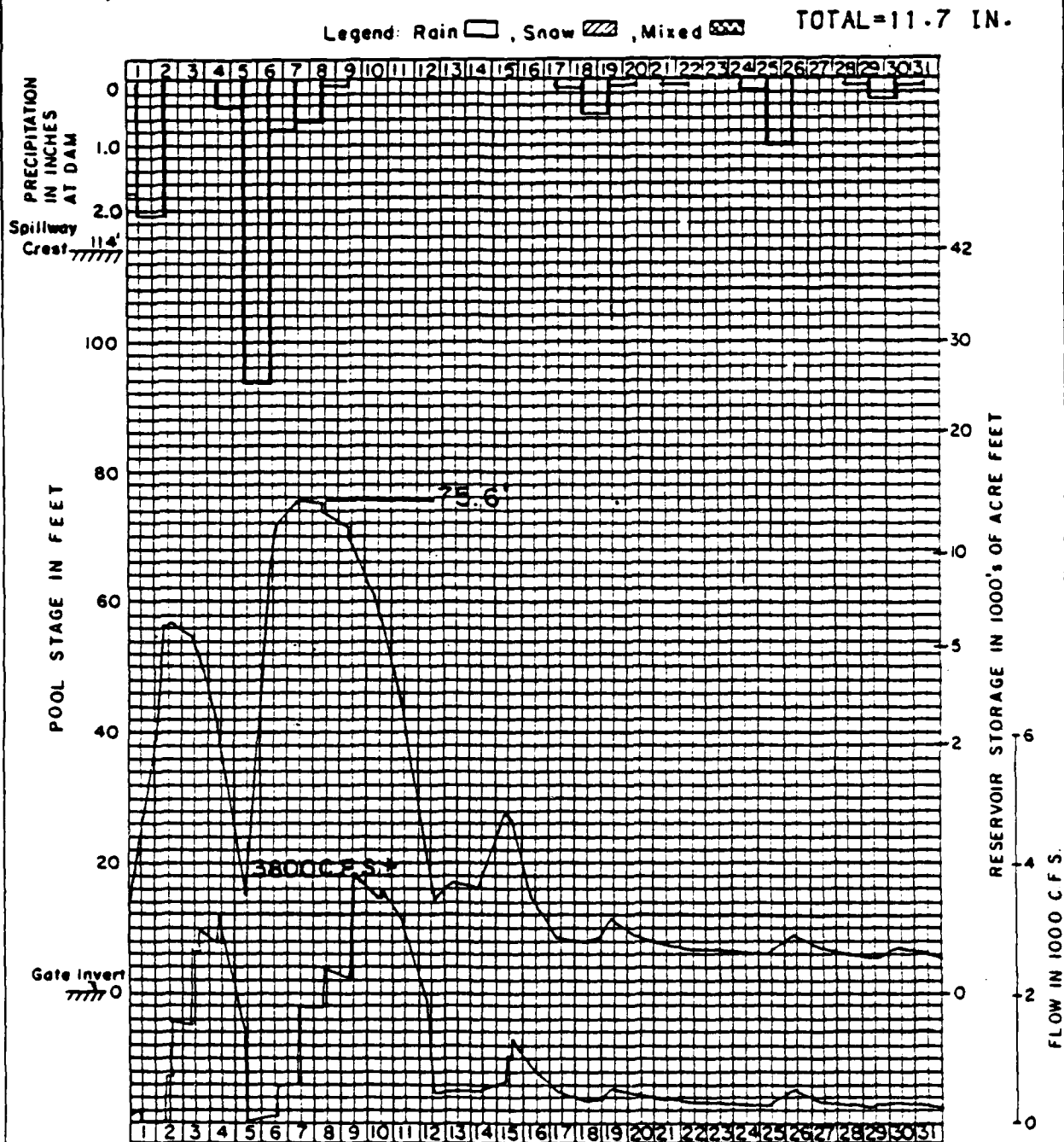
WEST HILL _____ RESERVOIR
BLACKSTONE _____ RIVER BASIN

D.A. = 28 SQ. MILES

1" R.O. = 1500 Ac - Ft.

NEW ENGLAND DIVISION
WALTHAM, MASS.

	ELEVATION MSL.	STAGE FEET	NET STORAGE AC-FT
Gate Invert	234.0	0	0
Permanent Pool	None	—	—
Spillway Crest	264.0	30.0	12,440
Outlet Capacity at Full Pool = 1480 c.f.s.			



MONTHLY RESERVOIR OPERATION

THOMASTON _____ RESERVOIR
HOUSATONIC _____ RIVER BASIN

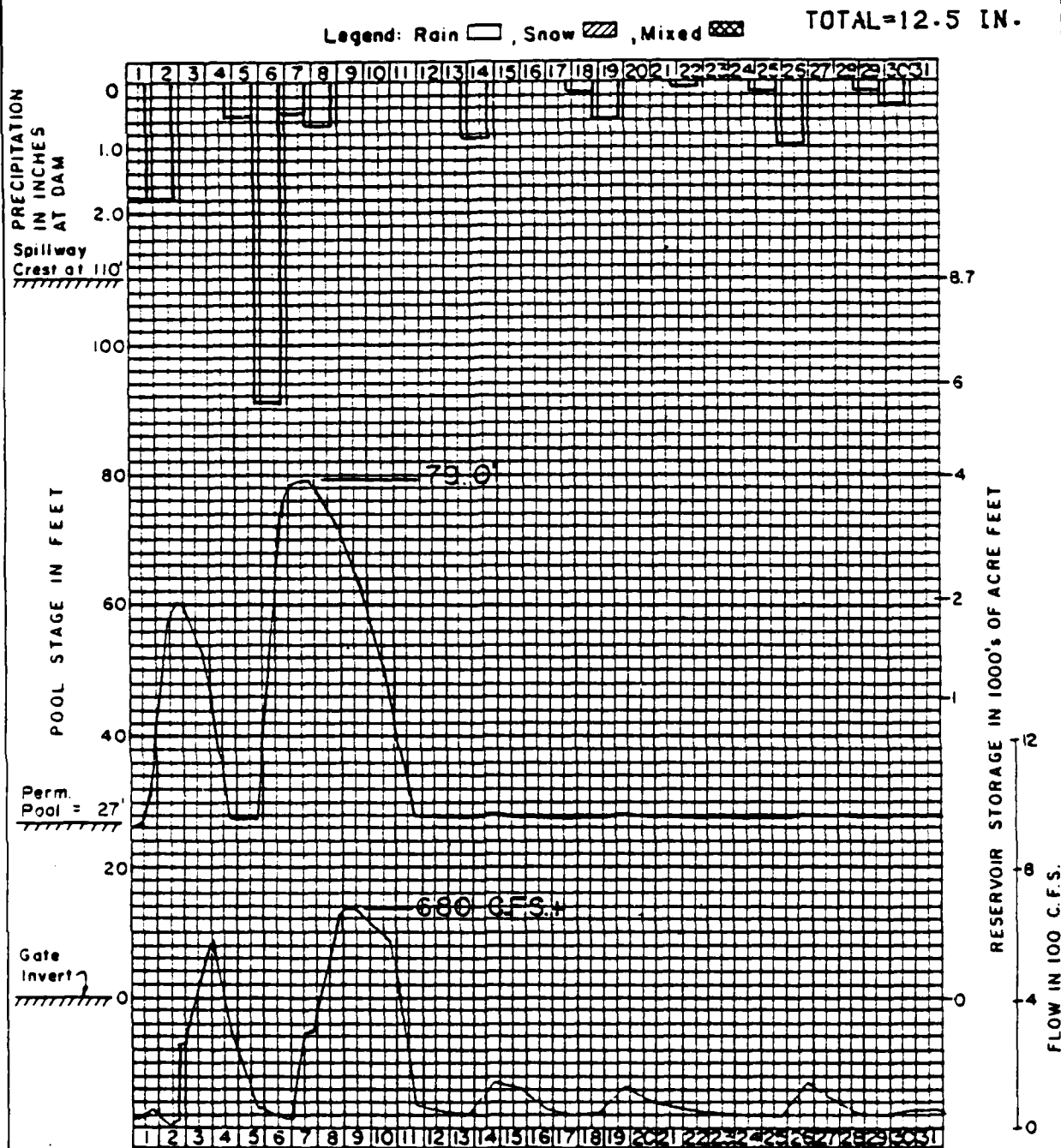
	ELEVATION	STAGE	GROSS
	MSL	FEET	STORAGE
			AC-FT
Gate Invert	380.0	0	0
Permanent Pool	—	—	—
Spillway Crest	494.0	114.0	42,000

Outlet Capacity at Full Pool = 5500 C.F.S.

D.A. = 97.2 SQ. MI. (TOTAL)
70.8 SQ. MI. (NET)

I.R.Q. = 5185 Ac. Ft. (TOTAL)
3775 Ac. Ft. (NET)

NEW ENGLAND DIVISION
WALTHAM, MASS.



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MONTHLY RESERVOIR OPERATION

BLACK ROCK RESERVOIR
HOUSATONIC RIVER BASIN

D.A. = 20.4 SQ. MILES

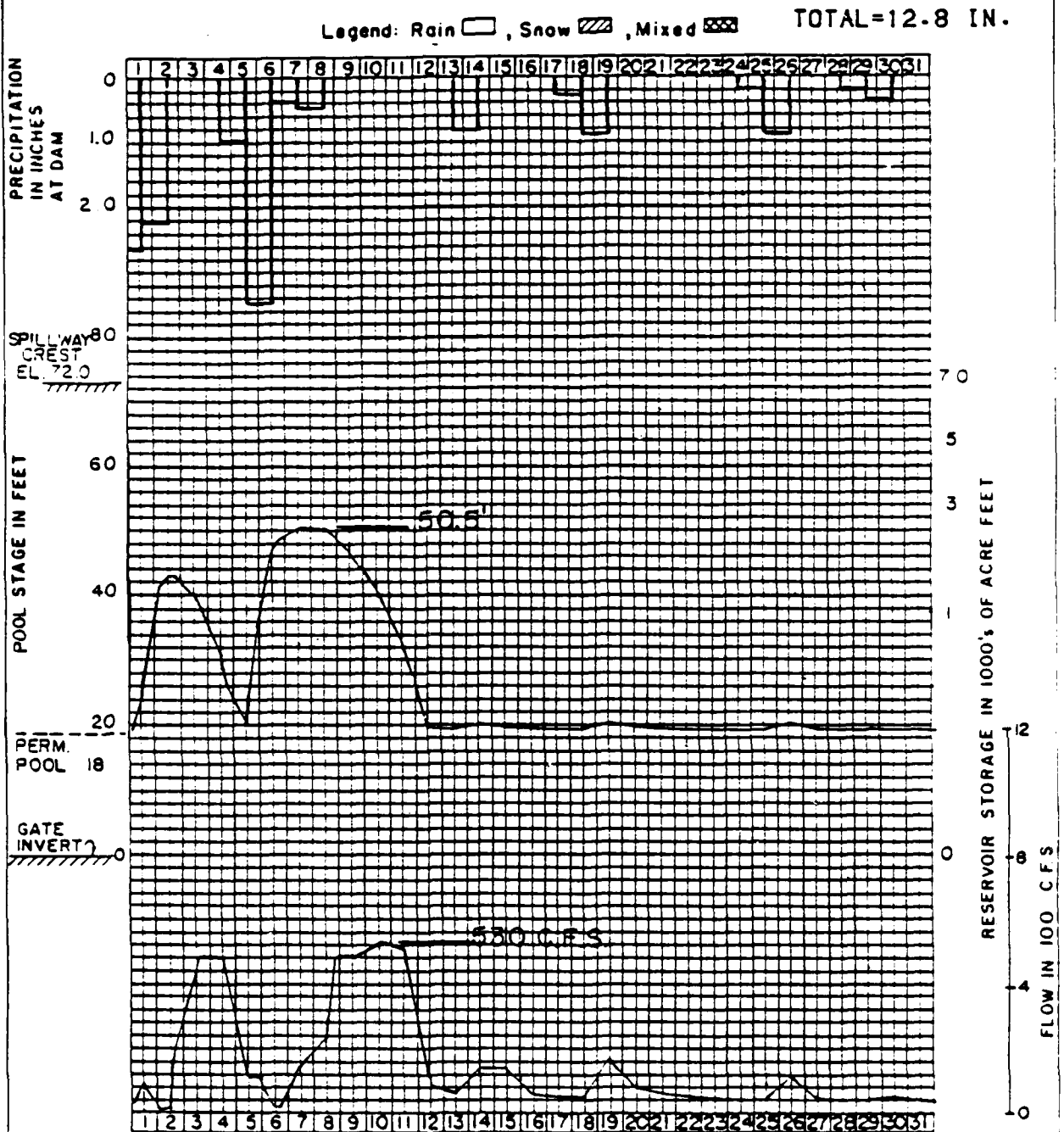
1" R.O. = 1090 Ac.-Ft.

NEW ENGLAND DIVISION

WALTHAM, MASS.

	ELEVATION MS.L.	STAGE FEET	GROSS STORAGE AC.-FT.
Gate Invert	410.0	0	0
Permanent Pool	435.0	25	250
Full Pool	520	110	8700

Outlet Capacity at Full Pool = 850 C.F.S.



31 MARCH - 30 APRIL 1987

MONTHLY RESERVOIR OPERATION

HOP BROOK RESERVOIR
HOUSATONIC RIVER BASIN

	ELEVATION (MSL)	STAGE (FEET)	GROSS STORAGE (AC-FT)
--	--------------------	-----------------	-----------------------------

Gate Invert	292.0	0	0
Recreation Pool	310	18	120
Spillway Crest	364	72.0	6970

Outlet Capacity at Full Pool = 600 C.F.S.

D.A. = 16.4 SQ. MILES

1" R.O. = 875 Ac - Ft

NEW ENGLAND DIVISION
WALTHAM, MASS.

FLOOD PEAKS AT SELECTED USGS GAGING STATIONS

Gaging Station	Drainage Area sq. mi.	Observed Peak Discharge		Computed Natural* Peak Discharge		Maximum Previous Flood		
		cfs	csm	cfs	csm	Date	cfs	csm
Penigewasett River at Plymouth, NH	622	48,100	77	-	-	3/19/36	65,400	105
Contoocook River at Henniker, NH	368	16,000	43	17,200±	47	8/21/38	22,200	60
Contoocook River at Penacook, NH (River Hill)	760	11,500	15	27,000±	36	3/20/36	46,800	62
Piscataquog River at Goffstown, NH	202	7,600	38	11,500±	57	9/21/38	21,900	108
North Nashua River at Fitchburg, MA	63.4	3,400	54	-	-	4/5/84	2,740	43
Nashua River at East Pepperell, MA	316	11,700	37	-	-	3/20/36	20,900	66
Concord River at Lowell, MA	307	5,410	18	-	-	1/28/79	5,410	18
Merrimack River at Lowell, MA	4,425	84,700	19	103,000±	23	3/20/36	173,000	39
Ipswich River nr. Ipswich, MA	125	3,550	28	-	-	3/20/36	2,680	21
Deerfield River at West Deerfield, MA	557	61,700	111	-	-	2/31/48	48,500	87
Lamprey River at New Market, NH	183	7,500	41	-	-	3/20/36	5,490	30

* Without Corps Reservoirs

EFFECT OF CORPS RESERVOIRS AT
SELECTED INDEX STATIONS - FLOOD OF APRIL 1987

<u>Index Station</u>	<u>Drainage Area Sq. Mi.</u>	<u>Observed Discharge cfs</u>	<u>Computed Natural Discharge cfs</u>	<u>Percent Reduction</u>
<u>Connecticut River Basin</u>				
Connecticut River at Montague City, MA	7,865	128,000	160,000	20
Connecticut River at at Holyoke, MA	8,309	125,000	157,000	20
Connecticut River at at Springfield, MA	9,587	141,000	174,000	19
Connecticut River at at Hartford, CT	10,480	139,200	163,500	15
Connecticut River at at Middletown, CT	10,869	140,500	165,000	15
Black River at at North Springfield, VT.	158	3,900	11,000	64
Millers River at at Athol, MA	280	3,000	7,500	60
Westfield River at Westfield, MA	497	21,000	46,000	54
W. Branch Farmington River at Unionville, CT	378	17,000	26,000	35
Farmington River at Rainbow, CT	591	16,000	22,000	27
<u>Merrimack River Basin</u>				
Merrimack River at Franklin Junction, NH	1,507	20,000	59,000	66
Merrimack River at at Concord, NH	2,385	29,000	72,500	60
Merrimack River at at Goffs Falls, NH	3,092	48,000	83,000	42
Merrimack River at Nashua, NH	3,982	75,000	94,000	20

EFFECT OF CORPS RESERVOIRS AT
SELECTED INDEX STATIONS - FLOOD OF APRIL 1987

<u>Index Station</u>	<u>Drainage Area Sq. Mi.</u>	<u>Observed Discharge cfs</u>	<u>Computed Natural Discharge cfs</u>	<u>Percent Reduction</u>
Merrimack River at Lowell, MA	4,635	84,700	103,000	18
Merrimack River at Haverhill, MA	4,900	86,000	103,500	17
Contoocook River at Peterboro, NH	118	3,300	5,600	41
Contoocook River at River Hill, NH (Penacook)	760	11,500	27,000	57
Piscataquog River at Goffstown, NH	202	7,600	11,500	34
<u>Thames River</u>				
French River at Webster, MA	85	950	3,000	68
Guinebaug River at Putnam, CT	331	4,100	10,500	61
Guinebaug River at Jewett City, CT	715	12,000	17,000	29
Shetucket River at Willimantic, CT	401	6,600	13,500	51
<u>Naugatuck River Basin</u>				
Naugatuck River at Thomaston, CT	100	3,800	12,000	68
Naugatuck River at Waterbury, CT	180	8,500	22,000	61
Naugatuck River at Beacon Falls, CT	259	10,800	27,000	60
<u>Blackstone River Basin</u>				
Blackstone River at Woonsocket, RI	416	10,000	11,000	9

FLOOD DAMAGES PREVENTED
FLOOD OF MARCH-APRIL 1987

Connecticut River Basin

<u>Reservoirs</u>		<u>Local Protection Projects</u>	
Ball Mountain Lake	\$ 18,342,000	Beaver Brook, NH	\$ 1,620,000
Barre Falls Dam	3,214,000	Chicopee, MA	386,000
Birch Hill Dam	9,065,000	East Hartford, CT	34,716,000
Colebrook River Lake	6,588,000	Gardner, MA	324,000
Knightville Dam	30,946,000	Hartford, CT	32,261,000
Littleville Lake	11,277,000	Holyoke and Springdale, MA	1,650,000
Mad River Dam	755,000	Northampton, MA	728,000
North Hartland Lake	12,050,000	Riverdale, MA	1,172,000
North Springfield Lake	13,923,000	Springfield, MA	3,365,000
Otter Brook Lake	3,593,000	Three Rivers, MA	0
Sucker Brook Dam	76,000	Ware, MA	0
Surry Mountain Lake	7,956,000	West Springfield, MA	39,473,000
Townshend Lake	14,196,000	West Warren, MA	0
Tully Lake	3,026,000		
Union Village Dam	4,188,000		
Sub-totals (Reservoirs)	\$139,195,000	Sub-Totals (LPP's)	\$115,695,000
Sub-Totals (Conn. River)	\$254,890,000		

Merrimack River Basin

<u>Reservoirs</u>		<u>Local Protection Projects</u>	
Blackwater Dam	\$ 6,090,000	Fitchburg, MA	\$ 66,000
Edward MacDowell Lake	1,839,000	Haverhill, MA	3,110,000
Everett Lake	6,176,000	Lincoln, NH	Site visit to be conducted
Franklin Falls Dam	7,261,000	Lowell, MA	0
Hopkinton Lake	18,375,000	Nashua, NH	65,000
		Saxtonville, MA	3,288,000
Sub-totals (Reservoirs)	\$ 39,741,000	Sub-totals (LPP's)	\$ 6,529,000
Sub-totals (Merr. River)	\$ 46,270,000		

Housatonic River BasinReservoirs

Black Rock Lake	\$ 19,324,000
East Branch Dam	6,285,000
Hall Meadow Brook Dam	4,890,000
Hancock Brook Lake	10,715,000
Hop Brook Lake	7,707,000
Northfield Brook Lake	5,235,000
Thomaston Dam	50,260,000
Sub-total (Reservoirs)	\$104,416,000
Sub-totals (Hous. River)	\$108,190,000

Blackstone River BasinReservoirs

West Hill Dam	\$ 3,738,000
Sub-total (Reservoirs)	\$ 3,738,000
Sub-total (B'atone River)	\$ 13,451,000

Thames River BasinReservoirs

Buffumville Lake	\$ 6,986,000
East Briafield, Lake	4,311,000
Hodges Village Dam	8,926,000
Mansfield, Hollow Lake	1,936,000
West Thompson Lake	3,152,000
Westville Lake	2,169,000
Sub-totals (Reservoirs)	\$ 27,480,000
Sub-total (Thames River)	\$ 27,535,000

Local Protection Projects

Ansonia, CT	\$ 1,354,000
Derby, CT	\$ 2,420,000
Torrington, CT (East Branch)	0
Torrington, CT (West Branch)	0
Waterbury-Watertown, CT	0
Sub-totals (LPP's)	\$ 3,774,000

Local Protection Projects

Blackstone, MA	\$ 293,000
Upper Woonsocket, RI	5,560,000
Lower Woonsocket, RI	773,000
Worcester Diveraion, MA	3,087,000
Sub-total (LPP's)	\$ 9,713,000

Local Protection Projects

Norwich, CT	\$ 55,000
Sub-totals (LPP's)	\$ 55,000

Coastal and Other LPP's

Canton, MA	\$ 43,000
Charles River Dam, MA	Awaiting Data from MDC
Charles River NVS	3,232,000
Fort Kent, ME	566,000
Haywood Creek, MA	556,000
Indian Island, ME	102,000
Salt Brook, MA	824,000
Hartland, ME	6,937,000
Sub-total (others)	\$ 12,260,000

<u>TOTALS</u>	\$462,596,000
Reservoirs	\$314,570,000
LPP's	\$148,026,000

Damages Prevented Summarized by States:

Connecticut	\$224,164,000
Massachusetts	201,684,000
New Hampshire	14,397,000
Rhode Island	9,975,000
Maine	7,605,000
Vermont	4,771,000
TOTAL	\$462,596,000

Damages Prevented by River Basin:

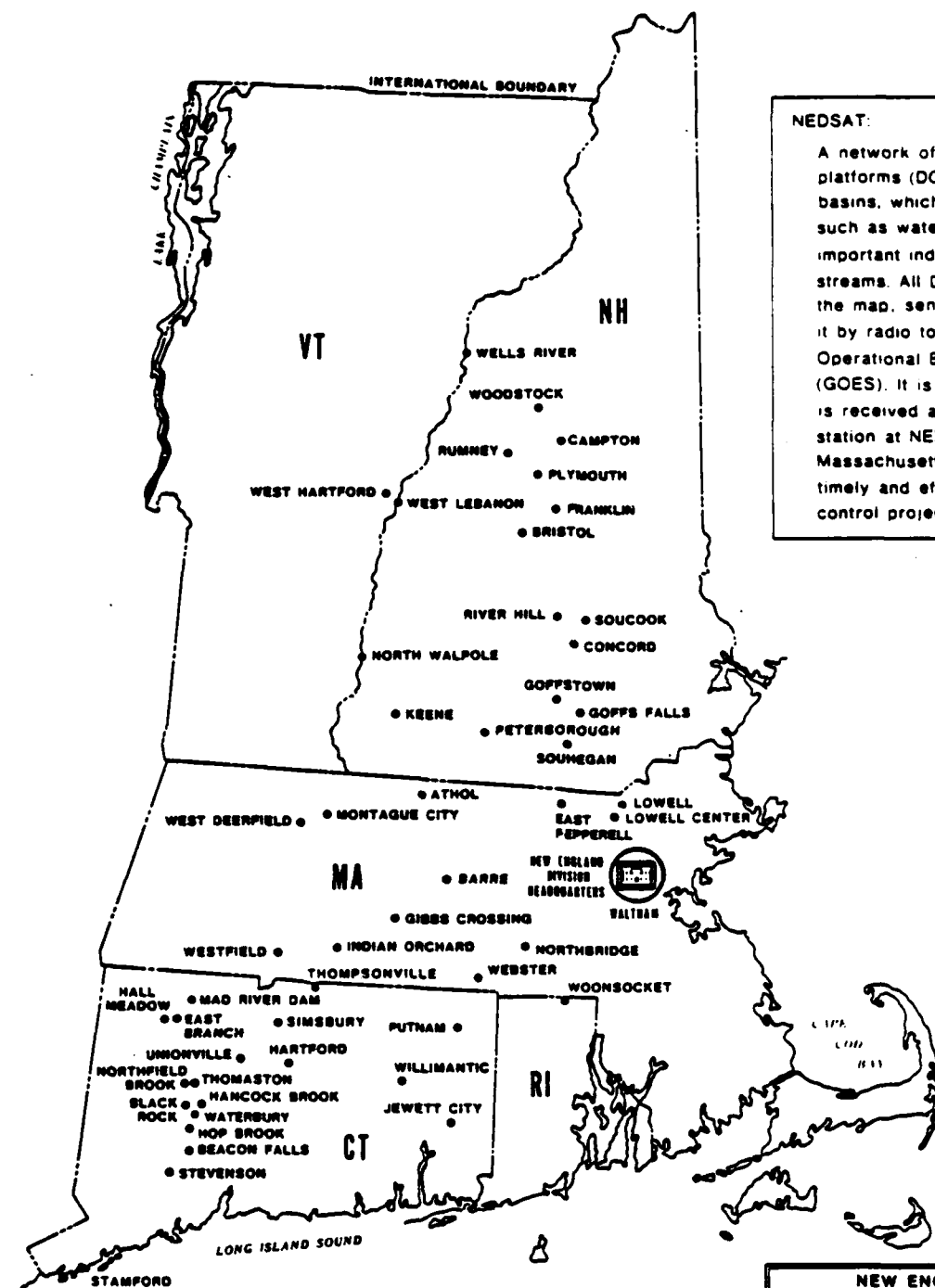
Connecticut	\$254,890,000
Naugatuck	108,190,000
Merrimack	46,270,000
Thames	27,535,000
Blackstone	13,451,000
Misc. LPP's	12,260,000
TOTAL	\$462,596,000

HOP-EV EVACUATIONS

Property owners in low-lying areas immediately downstream of the U.S. Army Corps of Engineers' Hopkinton-Everett flood control project, which includes the Hopkinton Dam on the Contoocook River in Hopkinton, N.H., and the Everett Dam on the Piscataquog River in East Weare, N.H., are being urged to prepare for possible evacuation of their homes.

Because of the more than five inches of heavy rain experienced over the past two days, the reservoirs behind Hopkinton and Everett dams are approaching maximum storage capacity. As a result, water is expected to begin flowing over the emergency spillway at Hopkinton Dam during Tuesday afternoon, and this condition could possibly cause damage to low-lying homes along the Contoocook River in Hopkinton, Concord, Penacook, Boscawen and Canterbury. If the reservoir levels continue to rise, emergency discharge could occur over the spillway at Everett Dam late Tuesday night and may cause damage to low-lying property along the Piscataquog River in Weare, Riverdale, Goffstown, Grasmere, Pinardville and Manchester.

The Army Engineers are closely monitoring the situation and will provide additional information as it becomes available. They report that the dams themselves are in no danger of failing, and that the emergency spillways were designed to handle much greater flows than those anticipated from this flood event.

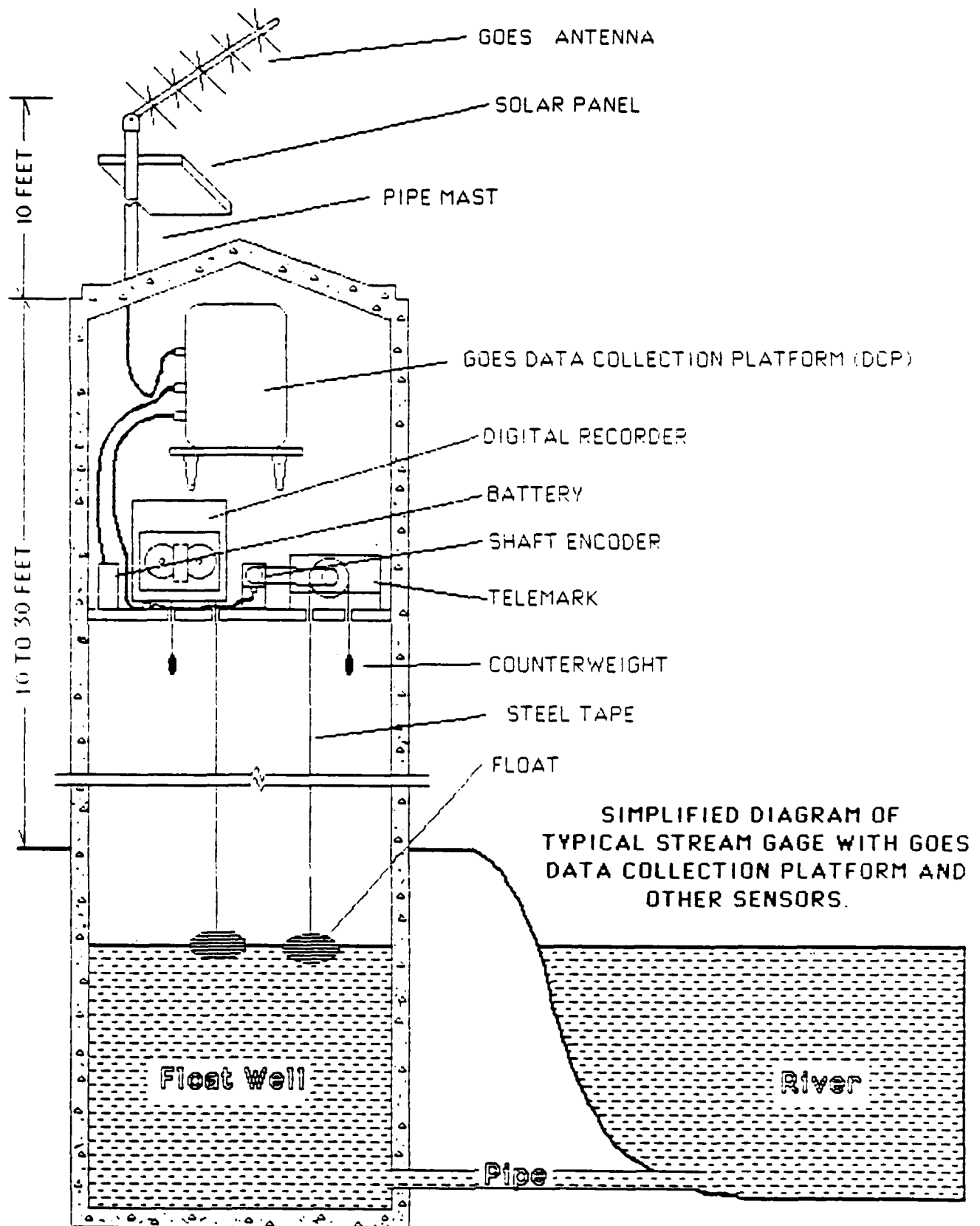


NEDSAT:

A network of remote, data collection platforms (DCP's) in five major river basins, which report hydrologic data, such as water level and rainfall, from important index stations on rivers and streams. All DCP's, shown by dots on the map, sense water data and transmit it by radio to NOAA's Geostationary Operational Environmental Satellite (GOES). It is relayed back to Earth, and is received at the satellite ground station at NED Headquarters in Waltham, Massachusetts. There it is used for timely and effective operation of flood control projects.

NEW ENGLAND DIVISION
NEDSAT
GOES SATELLITE
RANDOM REPORTING DATA
DATA COLLECTION SYSTEM

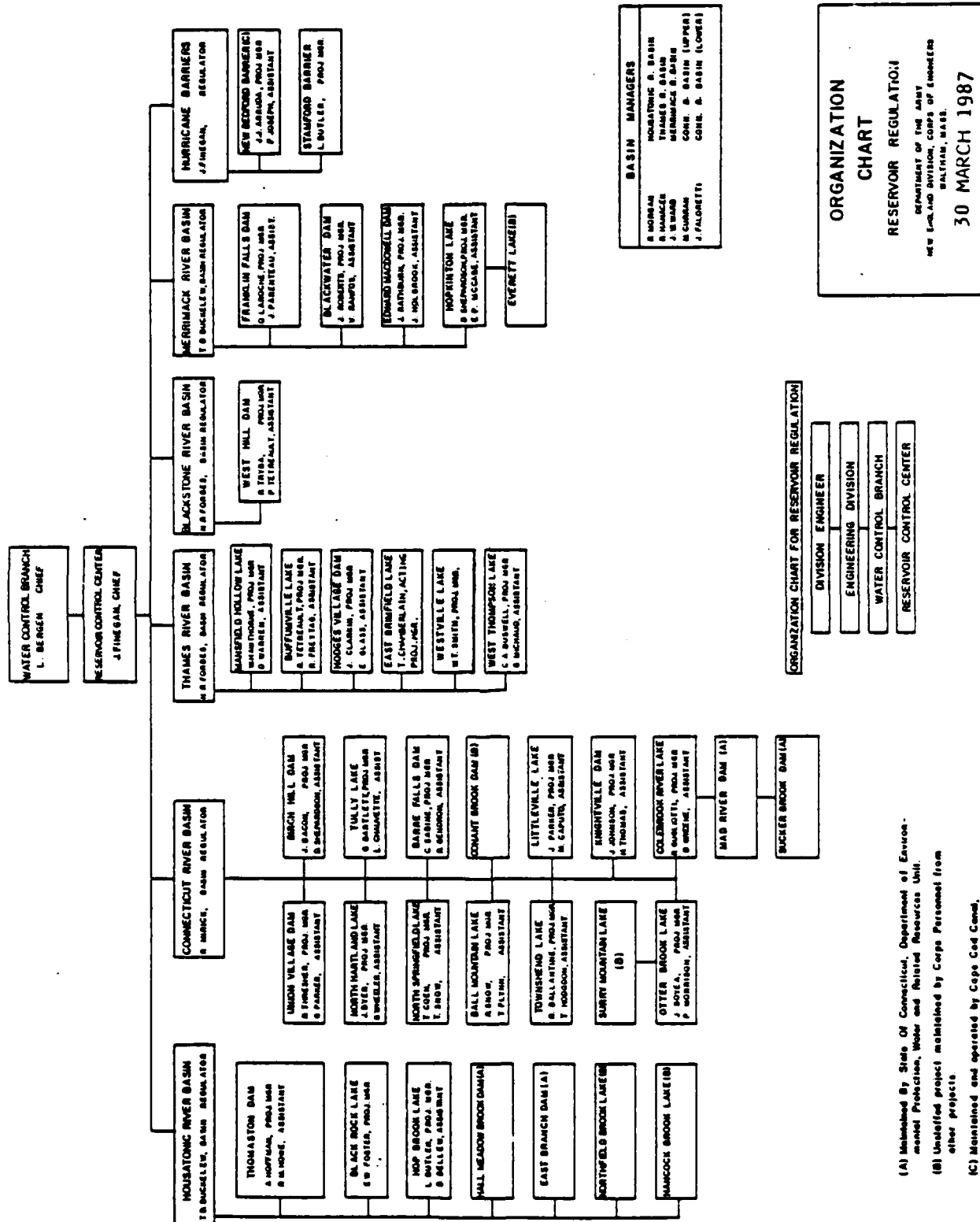
REVISED 4/86



Connecticut River at Montague City, Massachusetts
Gage Data for 4-5 April 1987
Drainage Area = 4865 Sq. Mi.

DATE	TIME	STAGE	DISCHARGE		MESSAGE	DCP
YY/MM/DD	HH:MM	(FT.)	(CFS)	(CSM)*	SEQ.NO.	STATUS WORD
87	4 4 0 6	26.55	71550.	9.1	.00	10637 004B4
87	4 4 0 50	26.45	71050.	9.0	.00	10638 004B4
87	4 4 1 8	26.39	70750.	9.0	.00	10639 004B4
87	4 4 1 57	26.28	70200.	8.9	.00	10640 004B4
87	4 4 2 44	26.12	69400.	8.8	.00	10641 004A4
87	4 4 4 42	25.31	65488.	8.3	.00	10643 04934
87	4 4 4 56	25.25	65200.	8.3	.00	10644 004B4
87	4 4 5 2	25.23	65104.	8.3	.00	10645 004B4
87	4 4 6 8	24.98	63908.	8.1	.00	10646 004B4
87	4 4 7 31	24.77	62942.	8.0	.00	10647 004B4
87	4 4 8 57	25.00	64000.	8.1	.00	10649 004B4
87	4 4 10 17	25.12	64576.	8.2	.00	10650 004B4
87	4 4 11 26	25.59	66832.	8.5	.00	10651 004A4
87	4 4 12 10	25.52	66496.	8.5	.00	10652 004B4
87	4 4 12 37	25.63	67024.	8.5	.00	10653 004B4
87	4 4 12 44	25.64	67072.	8.5	.00	10654 004B4
87	4 4 12 57	25.70	67360.	8.6	.00	10655 004A4
87	4 4 14 6	25.79	67792.	8.6	.00	10656 004A4
87	4 4 15 15	25.22	65056.	8.3	.00	10658 004A4
87	4 4 15 52	25.05	64240.	8.2	.00	10659 004A4
87	4 4 16 2	25.03	64144.	8.2	.00	10660 004A4
87	4 4 16 57	25.31	65488.	8.3	.00	10661 004B4
87	4 4 17 37	25.46	66208.	8.4	.00	10662 004A4
87	4 4 18 14	25.58	66784.	8.5	.00	10663 004A4
87	4 4 19 38	25.84	68032.	8.6	.00	10664 004A4
87	4 4 20 46	26.20	69800.	8.9	.00	10665 004B4
87	4 4 22 43	27.59	76868.	9.8	.00	10666 004B4
87	4 5 0 35	29.26	85604.	10.9	.00	10667 004B4
87	4 5 3 29	31.02	95110.	12.1	.00	10668 004B4
87	4 5 4 46	31.75	99125.	12.6	.00	10670 004B4
87	4 5 6 44	32.47	103320.	13.1	.00	10671 004B4
87	4 5 7 15	32.46	103260.	13.1	.00	10672 004B4
87	4 5 8 12	32.48	103380.	13.1	.00	10673 004B4
87	4 5 8 21	32.58	103980.	13.2	.00	10674 004B4
87	4 5 9 37	32.70	104700.	13.3	.00	10675 004B4
87	4 5 10 22	32.68	104580.	13.3	.00	10676 004A4
87	4 5 12 34	32.48	103380.	13.1	.00	10678 004B4
87	4 5 16 41	31.94	100170.	12.7	.00	10681 004B4
87	4 5 18 20	31.64	98520.	12.5	.00	10682 004B4
87	4 5 19 17	31.50	97750.	12.4	.00	10683 004B4
87	4 5 20 31	31.38	97090.	12.3	.00	10684 004B4
87	4 5 22 6	31.34	96870.	12.3	.00	10685 004B4
87	4 5 23 24	31.31	96705.	12.3	.00	10686 004B4
87	4 5 23 29	31.33	96815.	12.3	.00	10687 004B4

* Discharges are given in cubic feet per second (cfs)
and cfs per square mile (csm).



(A) Maintained By State Of Connecticut, Department of Environmental Protection, Water and Related Resources Unit.

(B) Unserved project maintained by Corps Personnel from other projects.

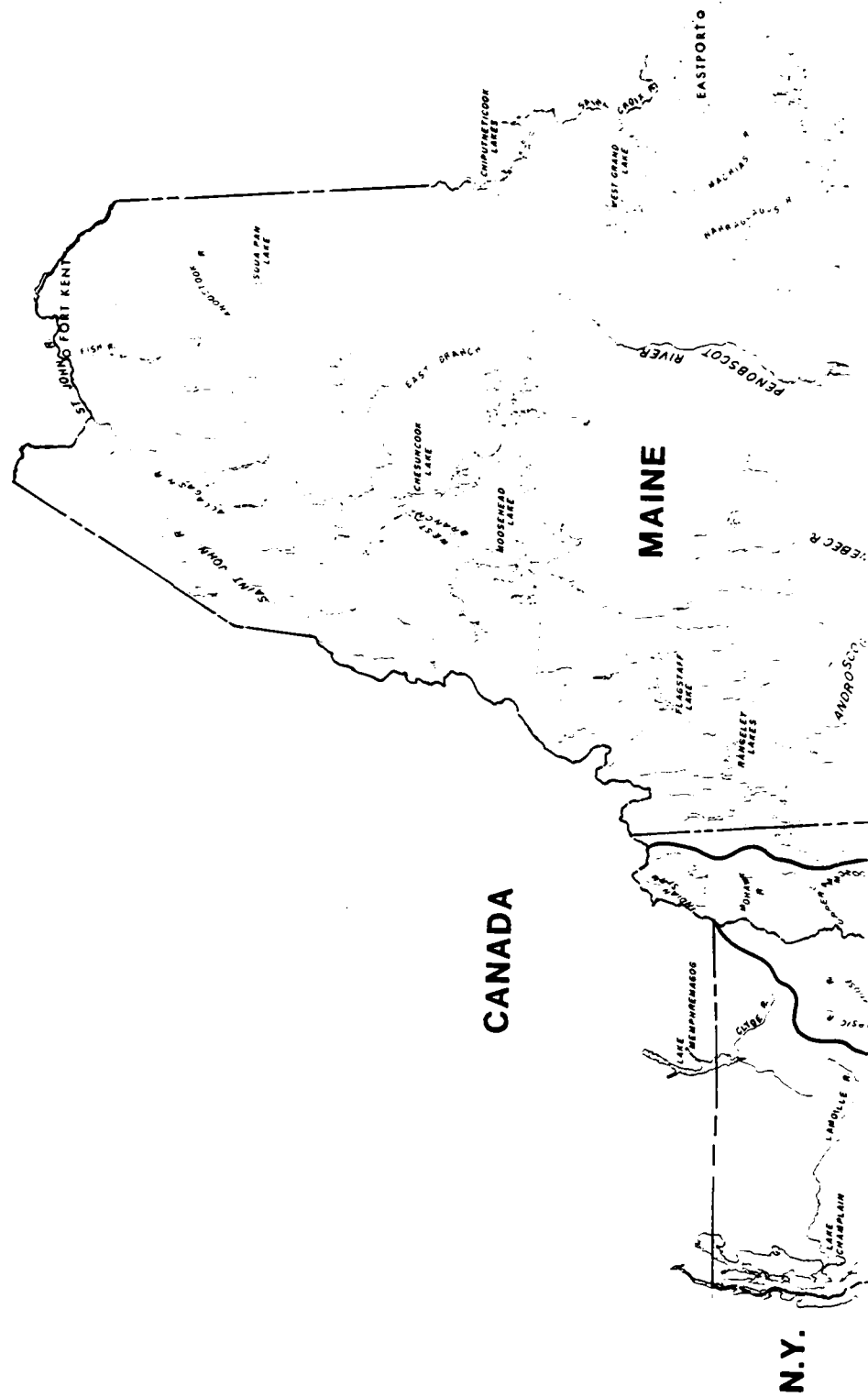
(C) Maintained and operated by Corps God Canal, Regulation for Hurricanes by R. C. C.

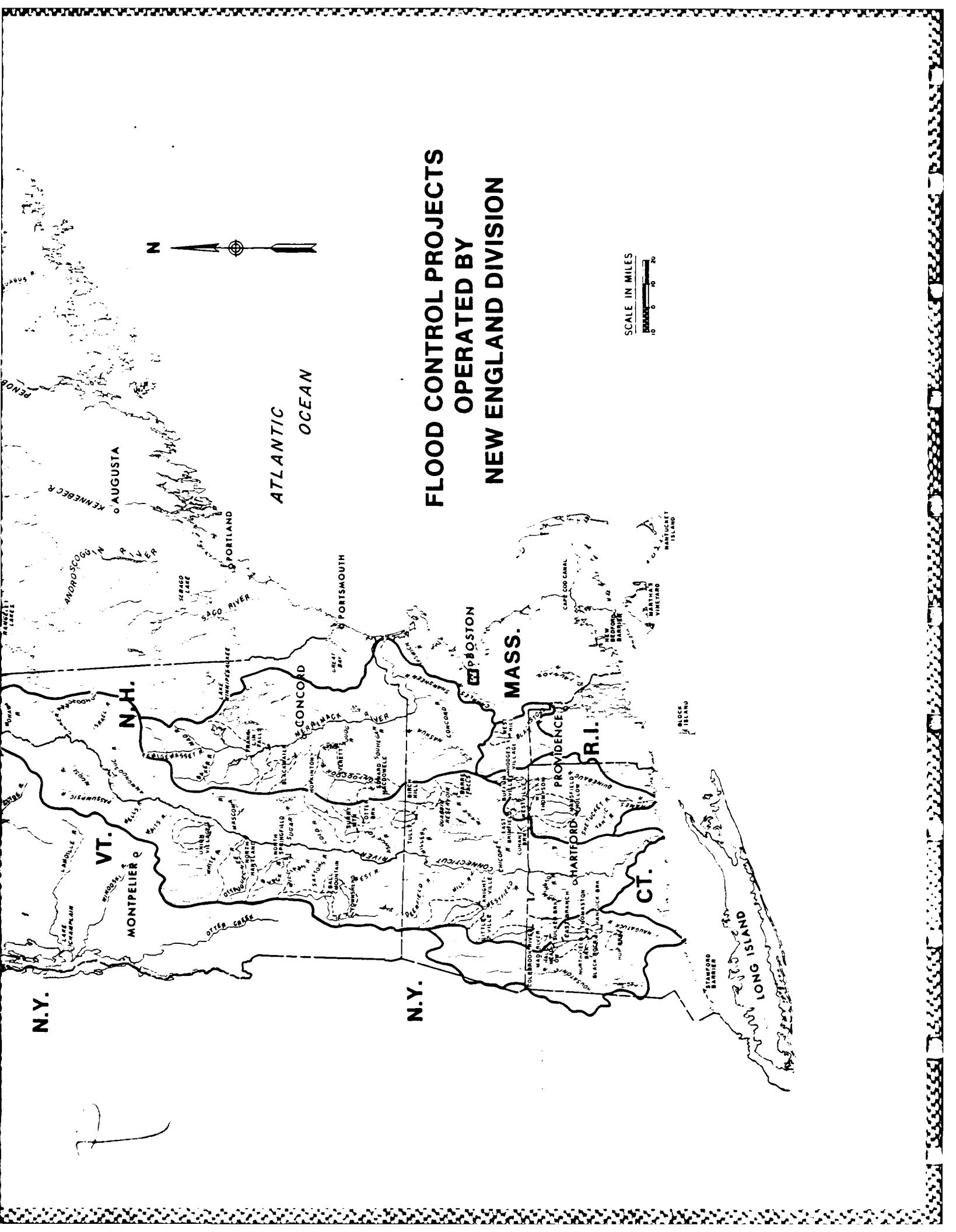
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APPENDIX A

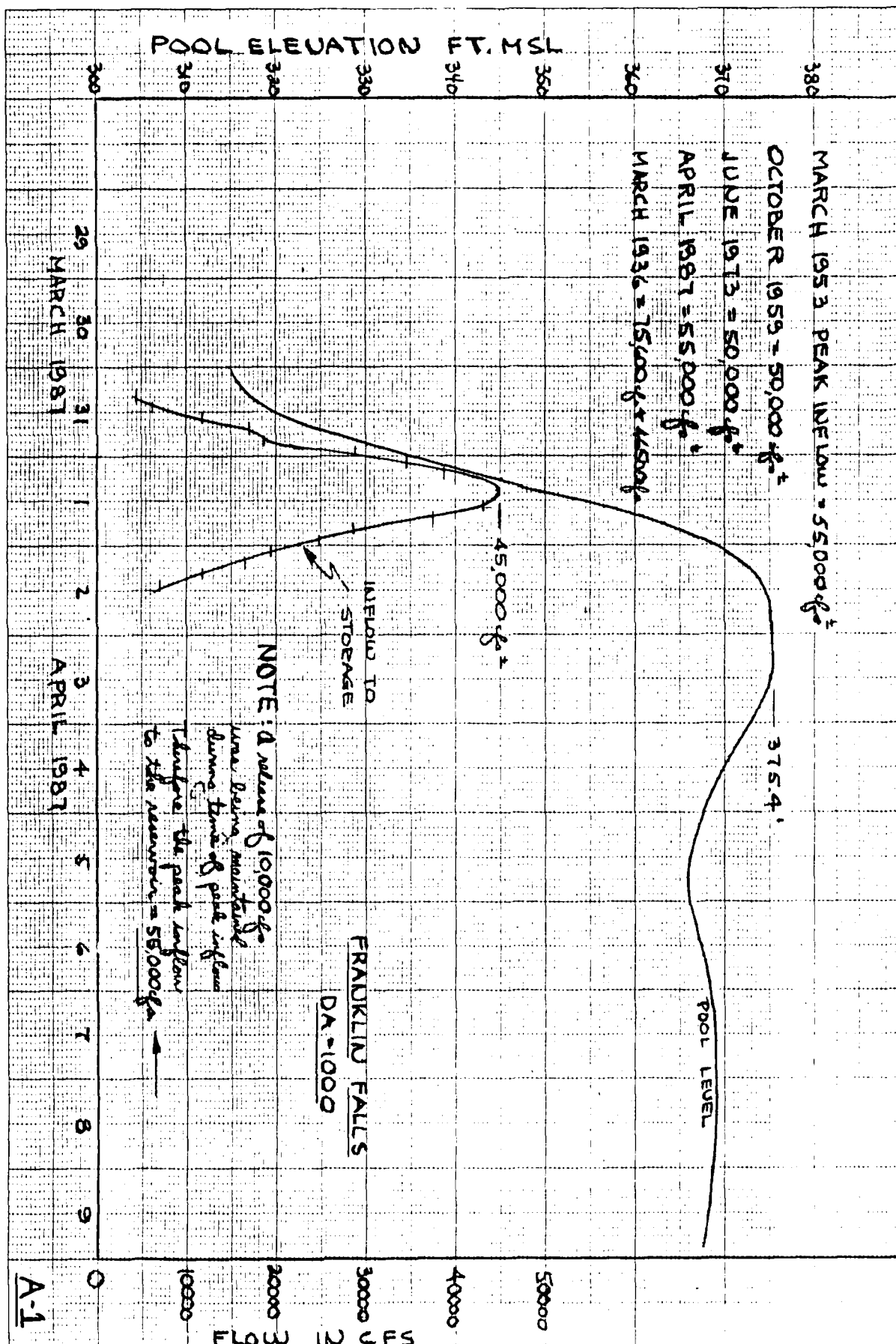
This section consists of a reservoir location map, selected RCC worksheets showing reservoir levels and computed reservoir inflows during the flood event, as well as observed and computed natural flows at selected gaging stations. Previous flood data is also listed for comparison.

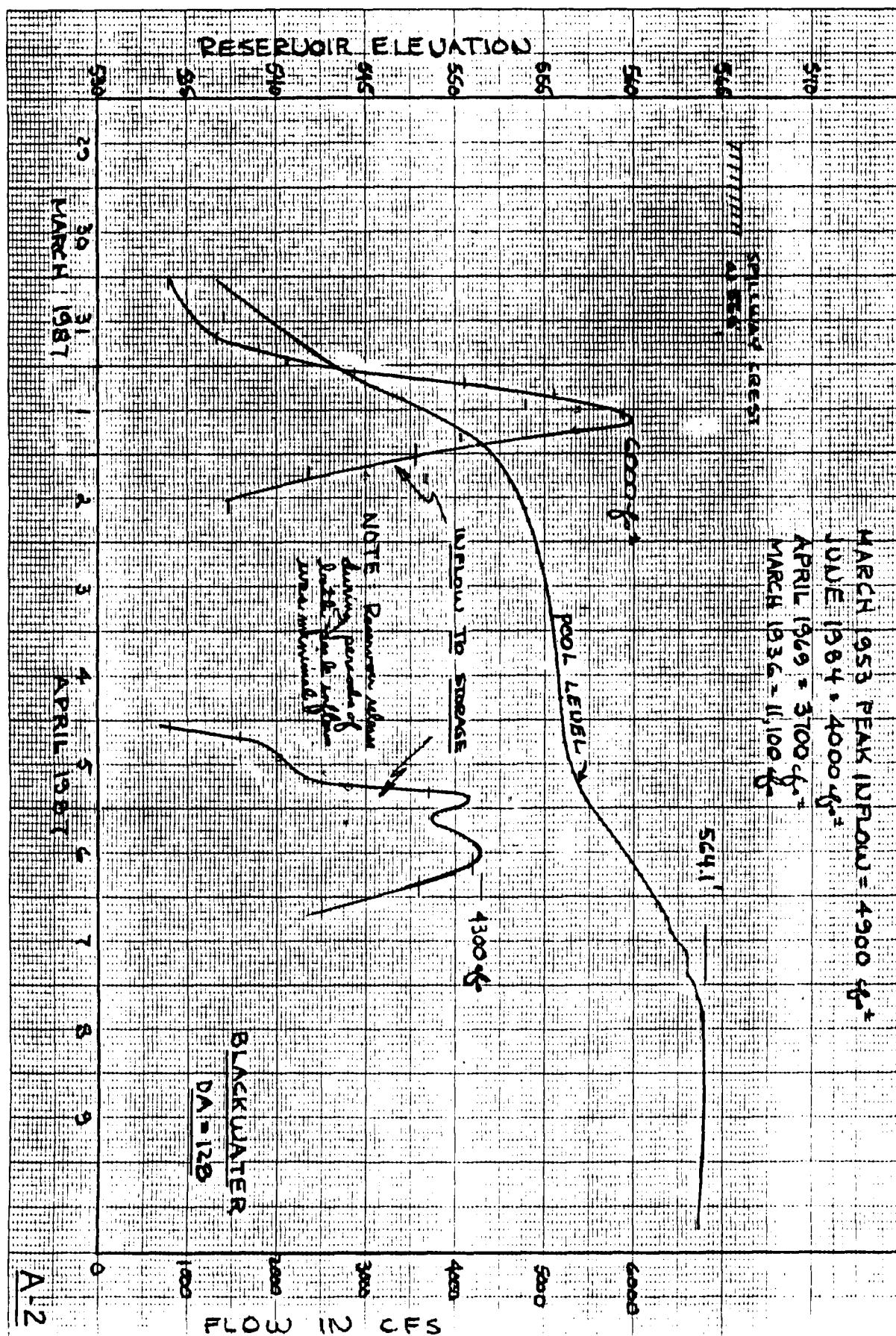
<u>Basin</u>	<u>Worksheet Numbers</u>
Merrimack River	A-1 thru A-10
Connecticut River	A-11 thru A-31
Thames and Blackstone Rivers	A-32 thru A-42
Naugatuck River	A-43 thru A-48

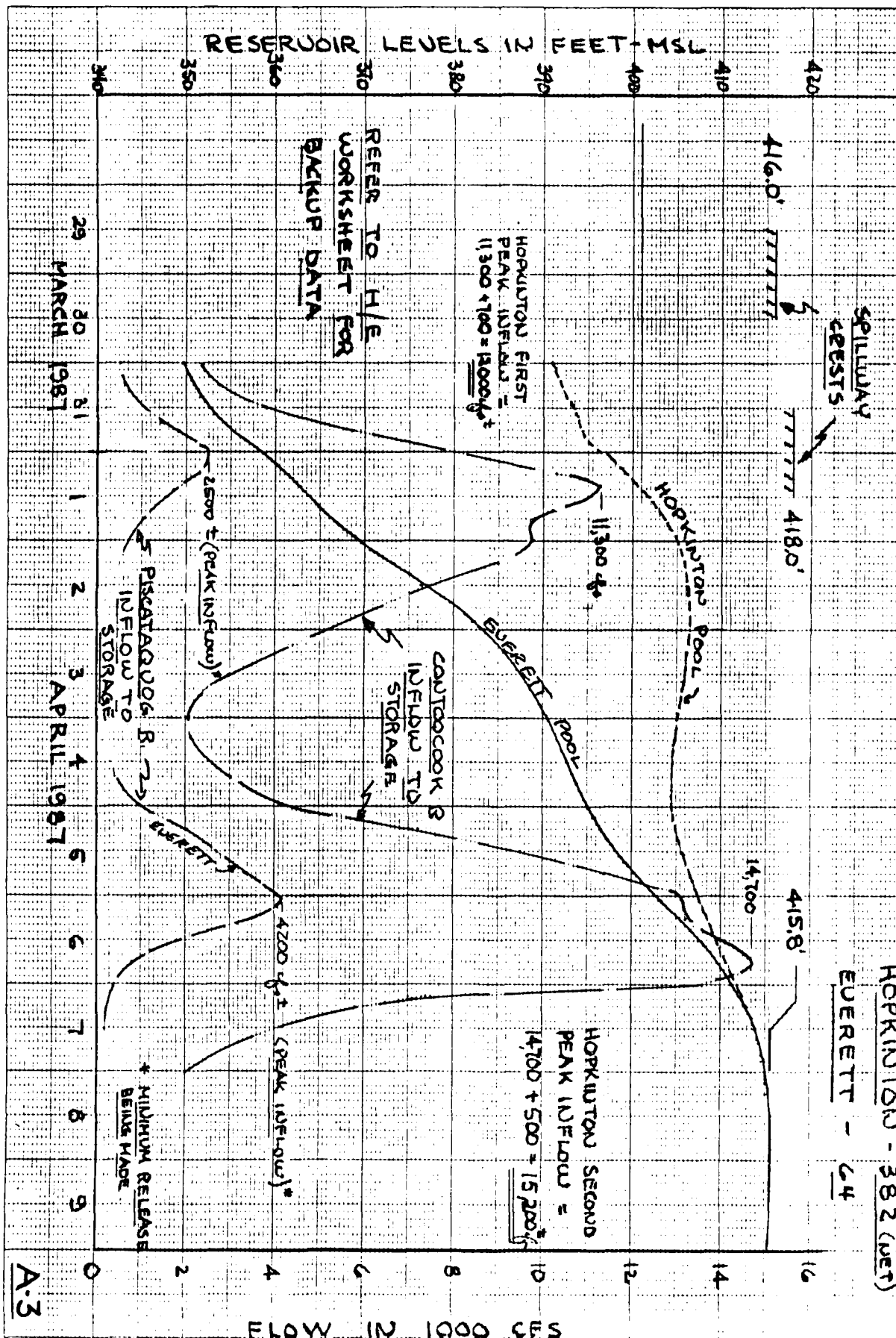


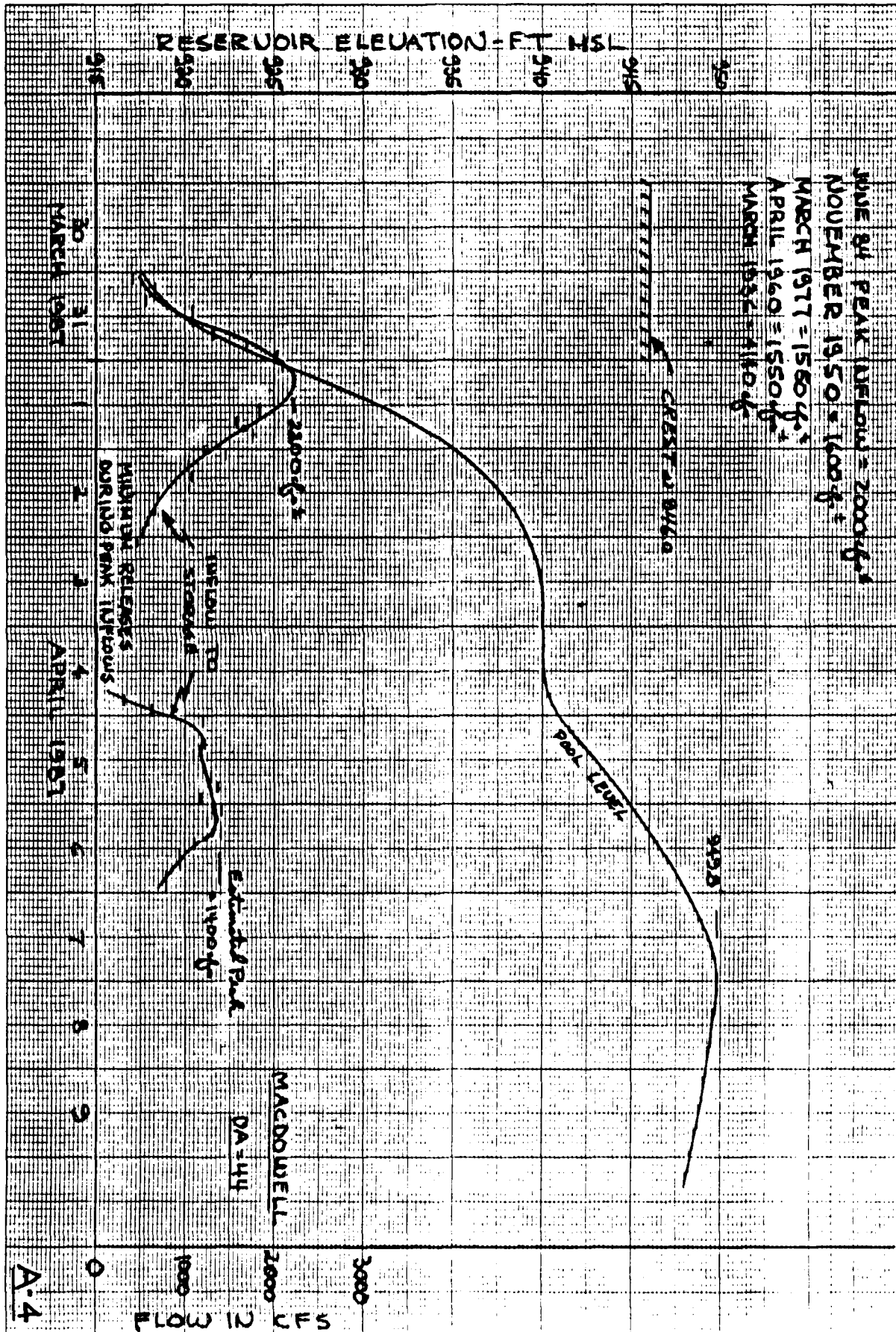


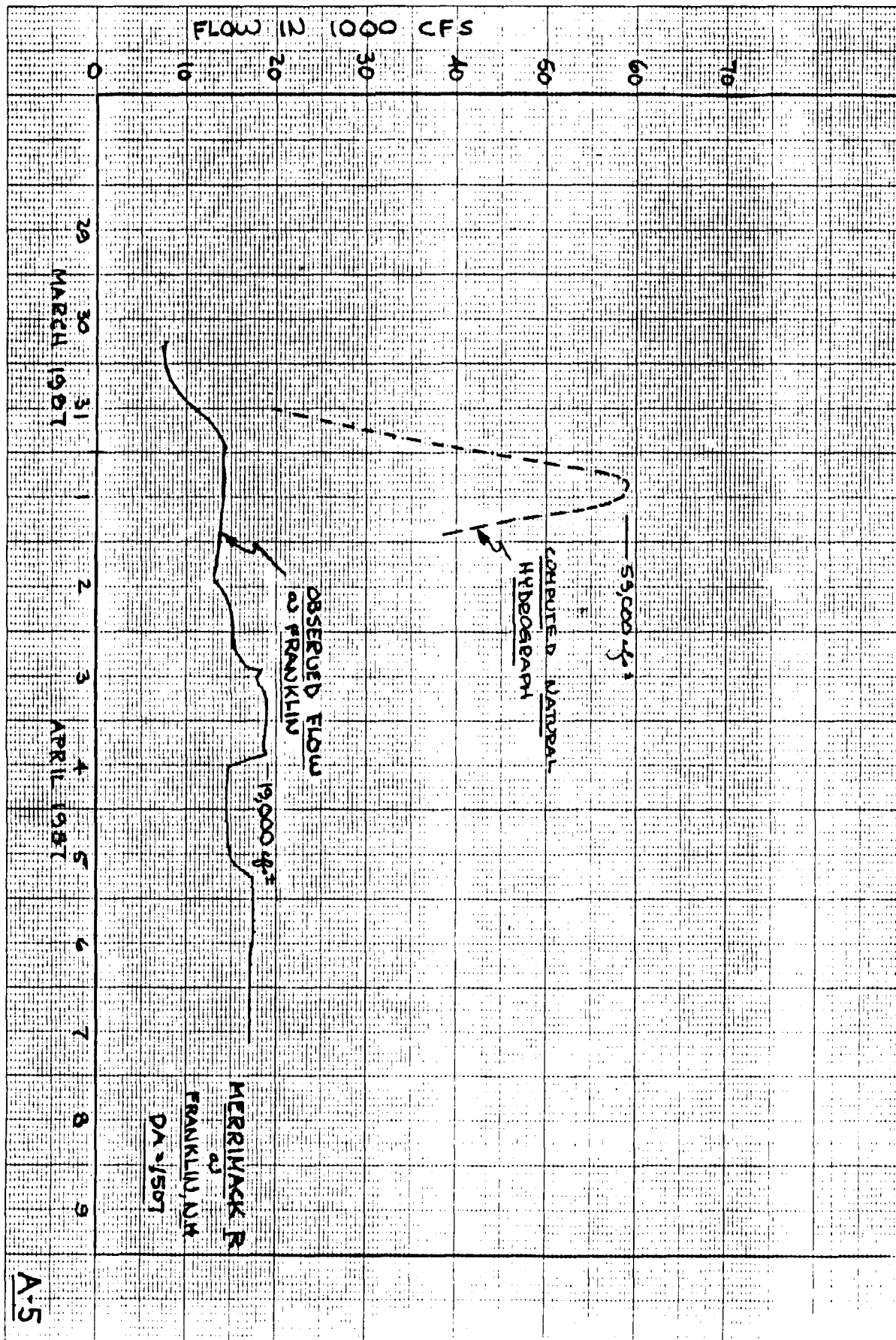
FLOOD CONTROL PROJECTS OPERATED BY NEW ENGLAND DIVISION

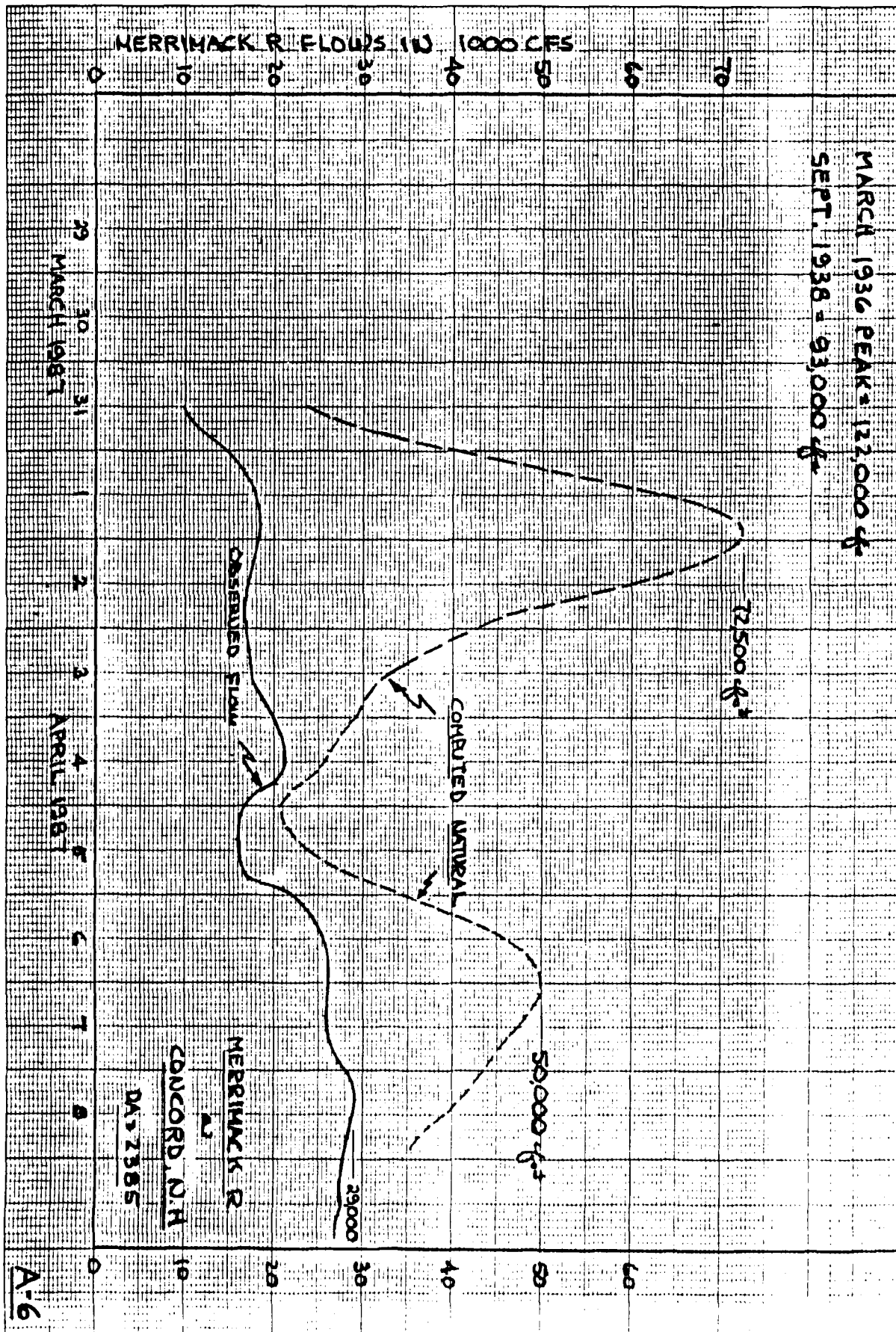




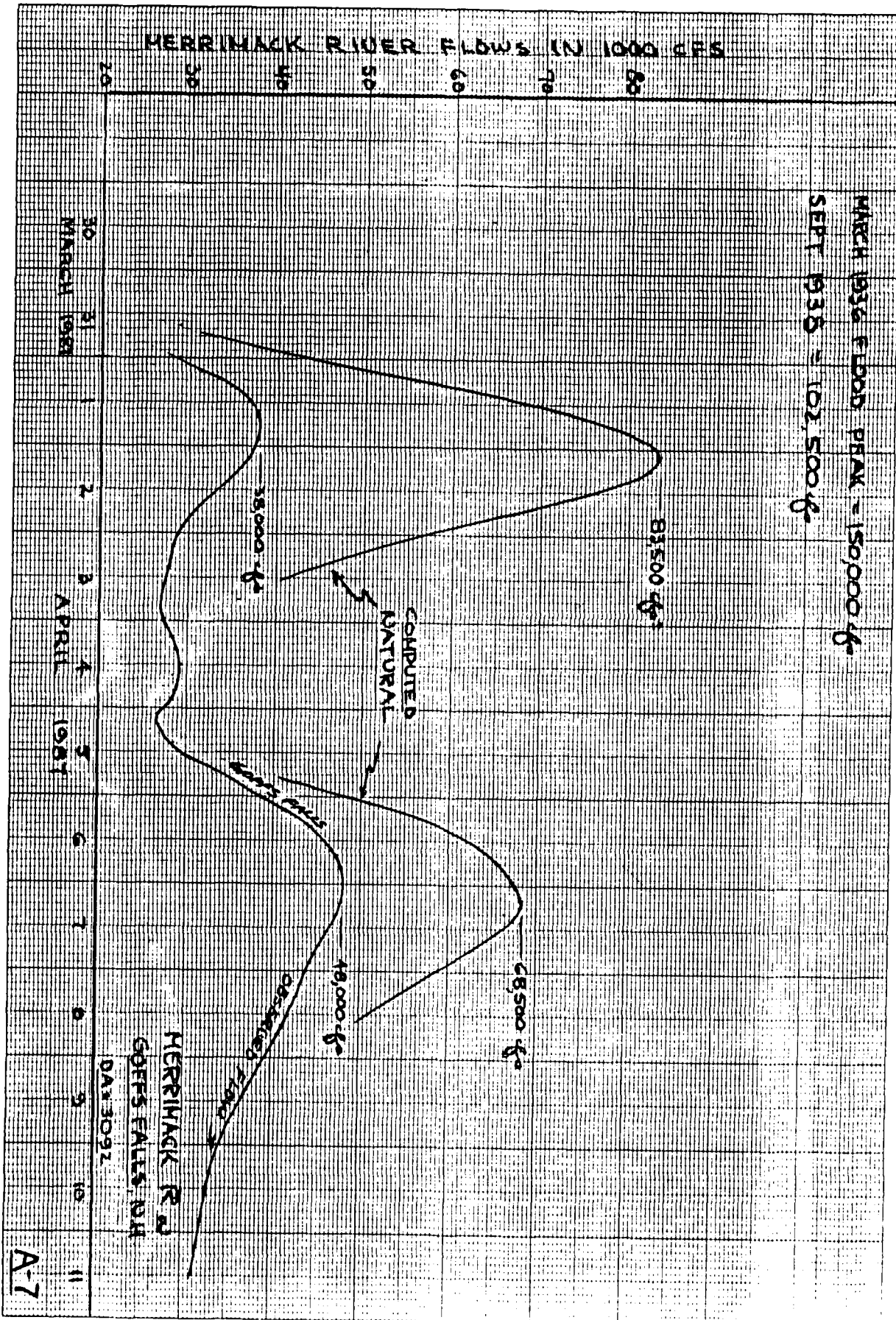






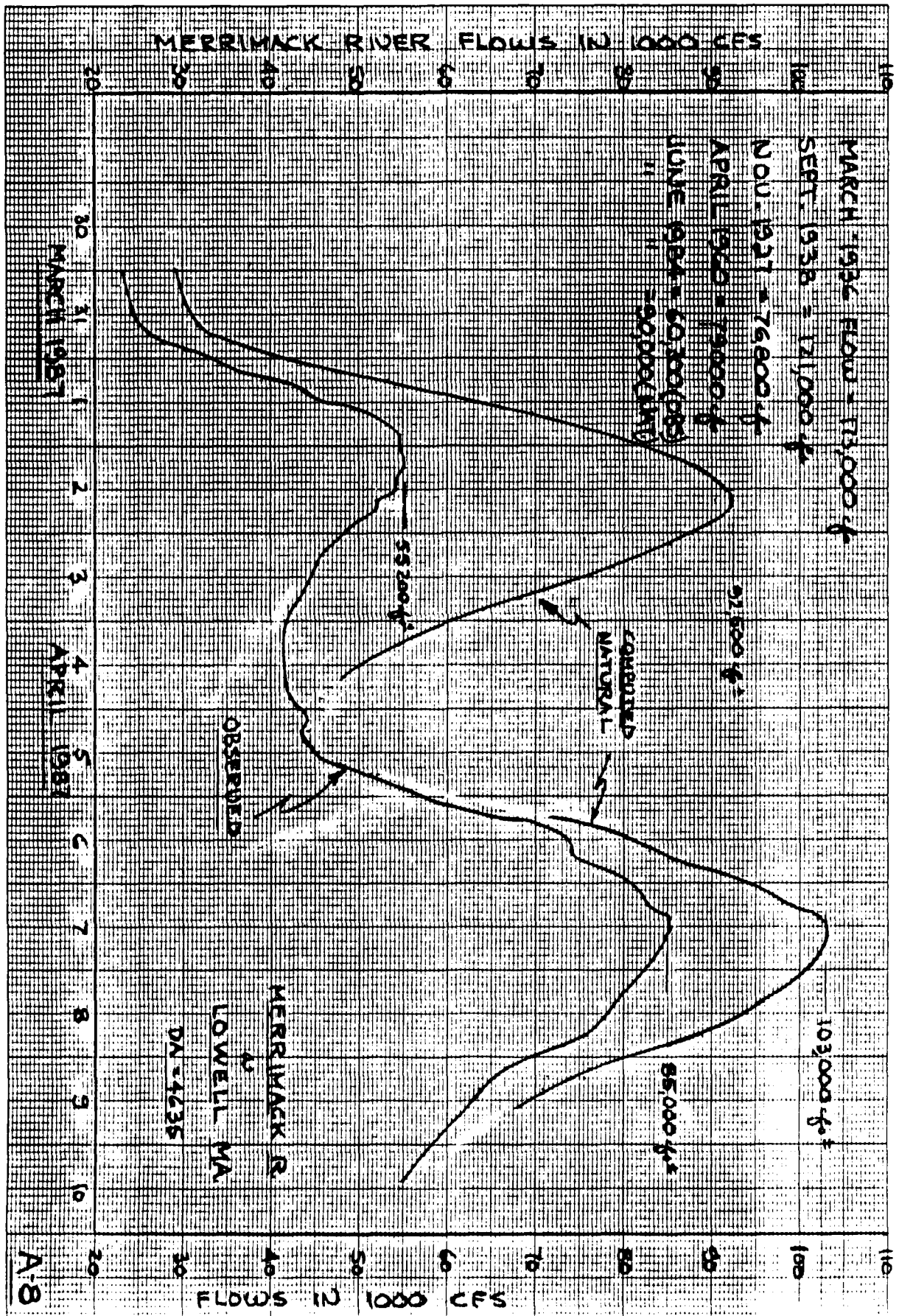


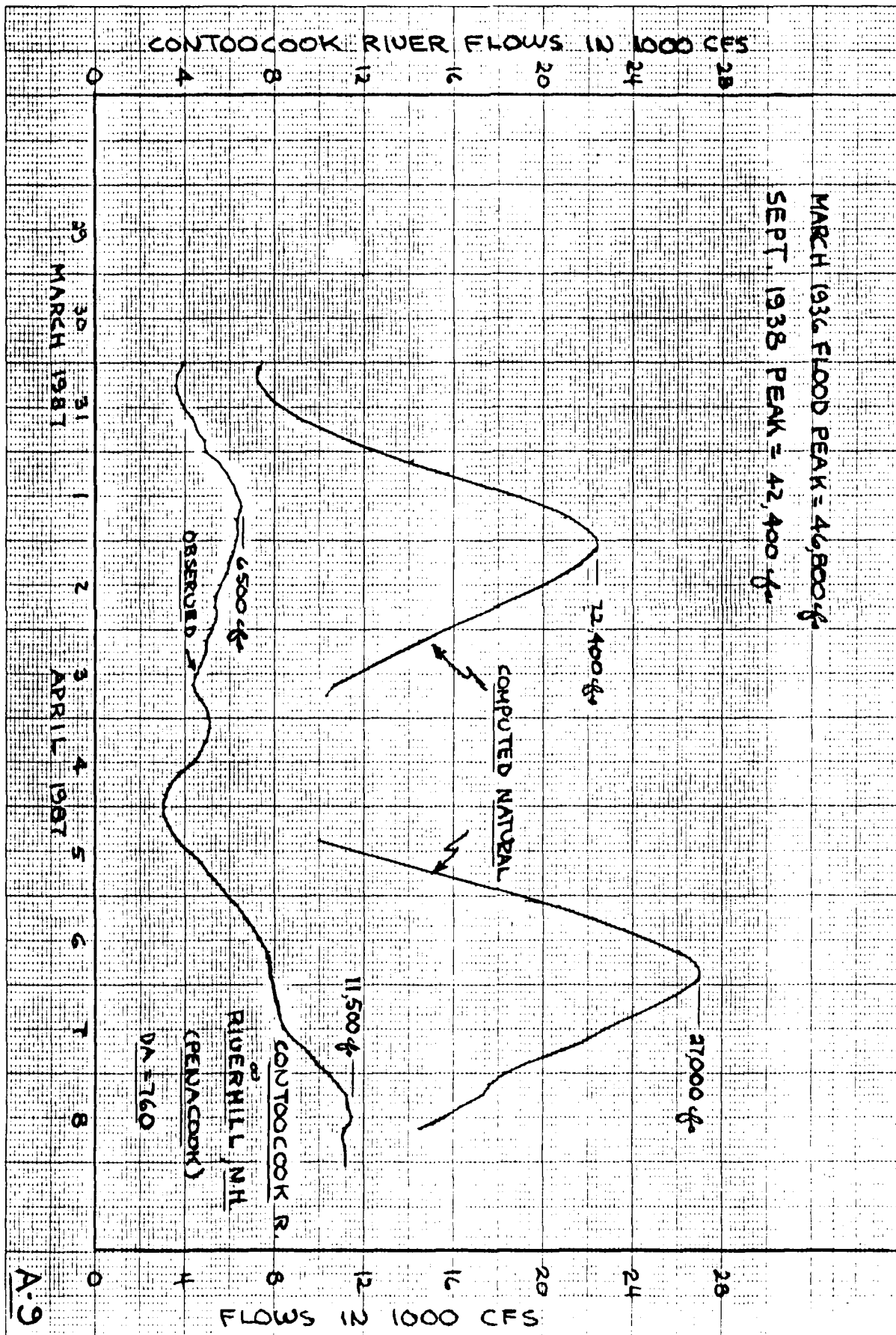
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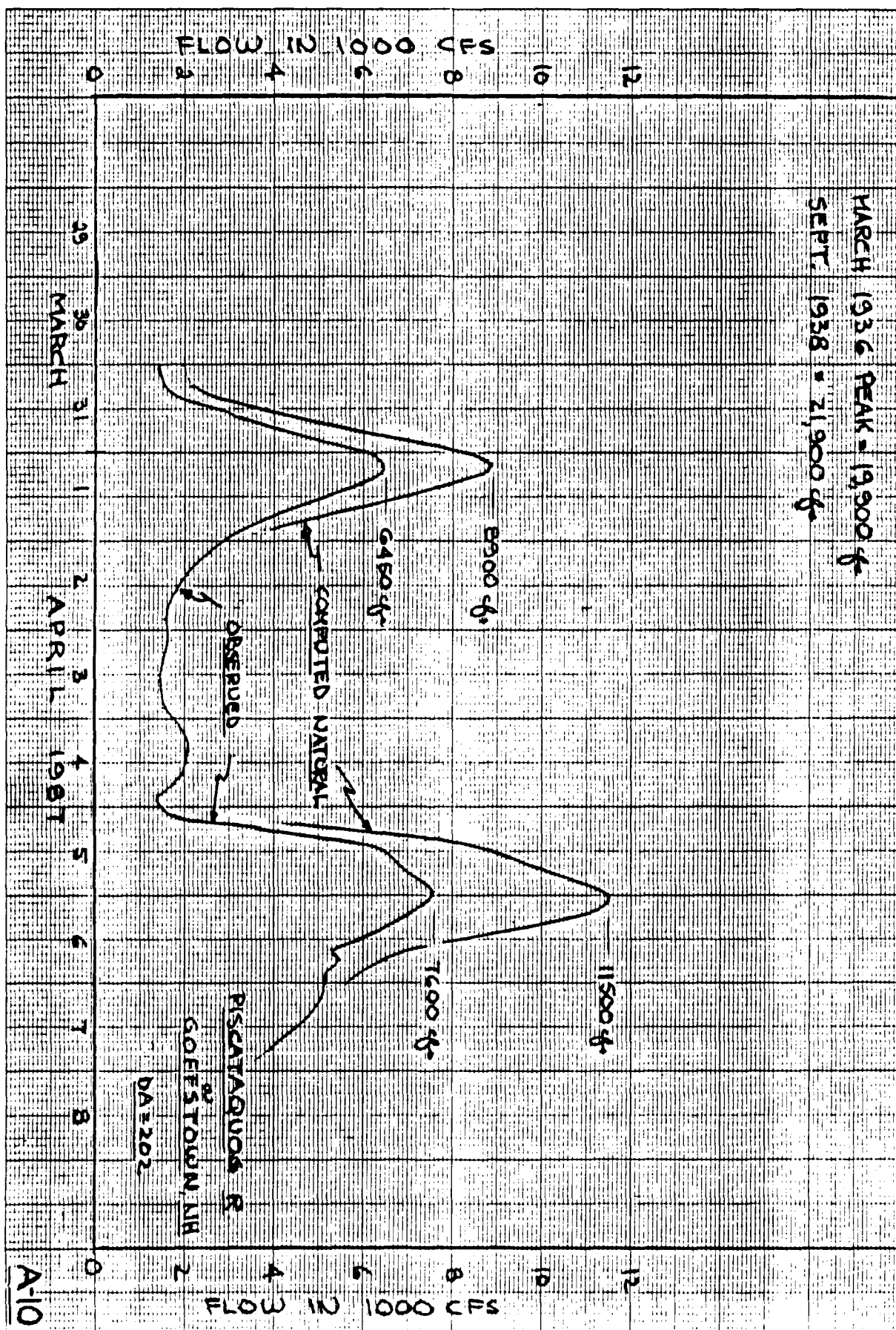


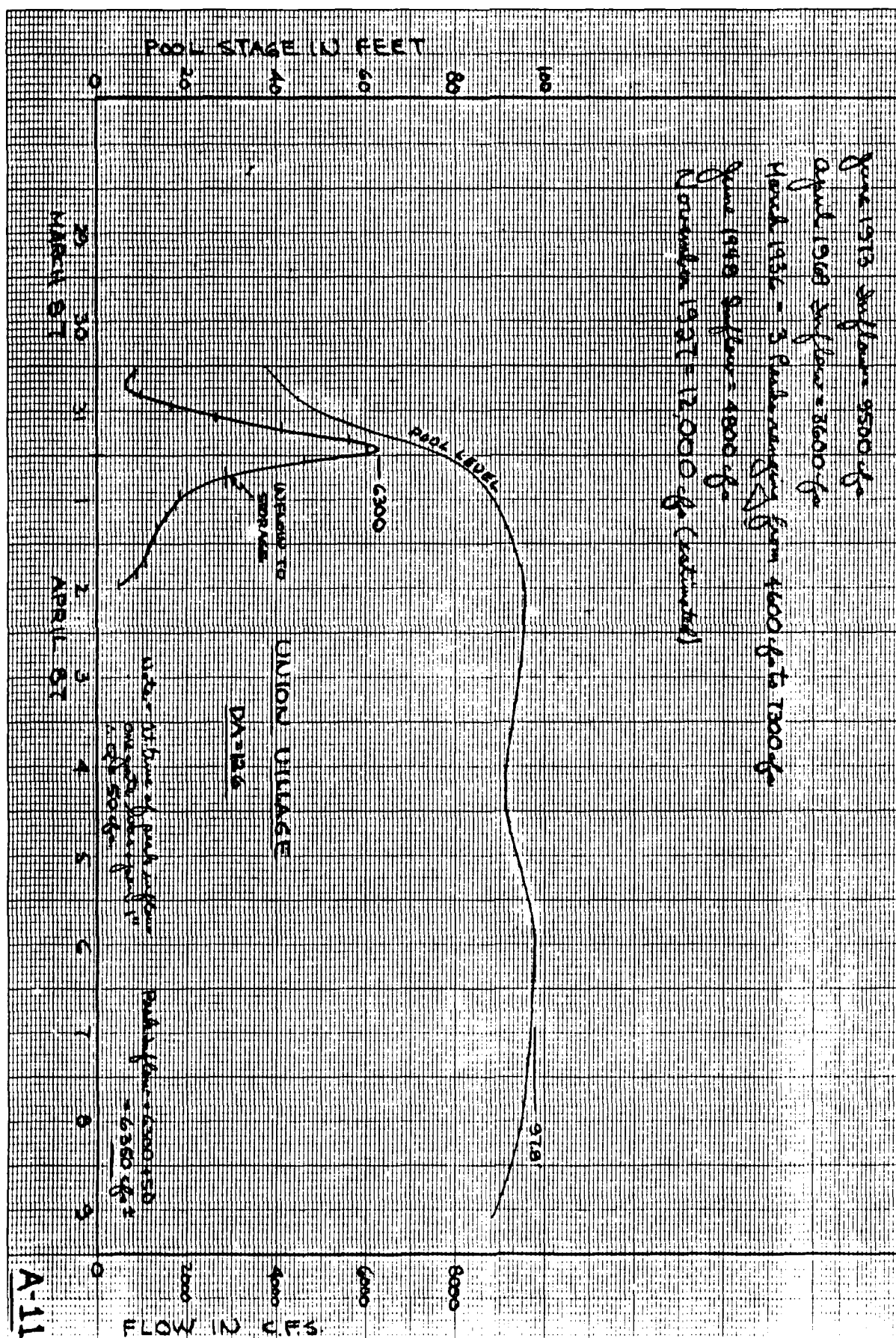
MARCH 1936 FLOOD PEAK = 150,000 cfs
SEPT 1935 = 102,500 cfs

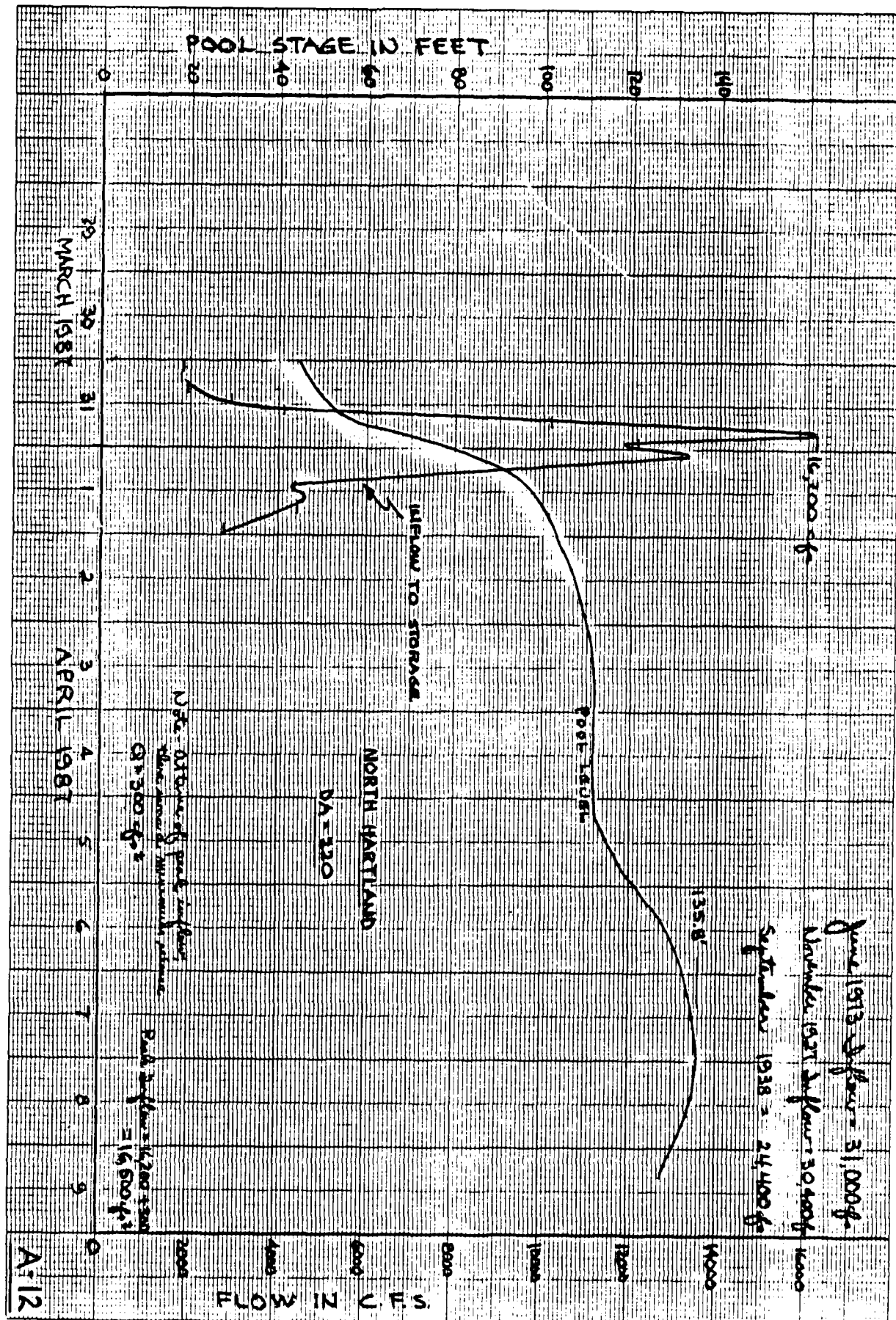
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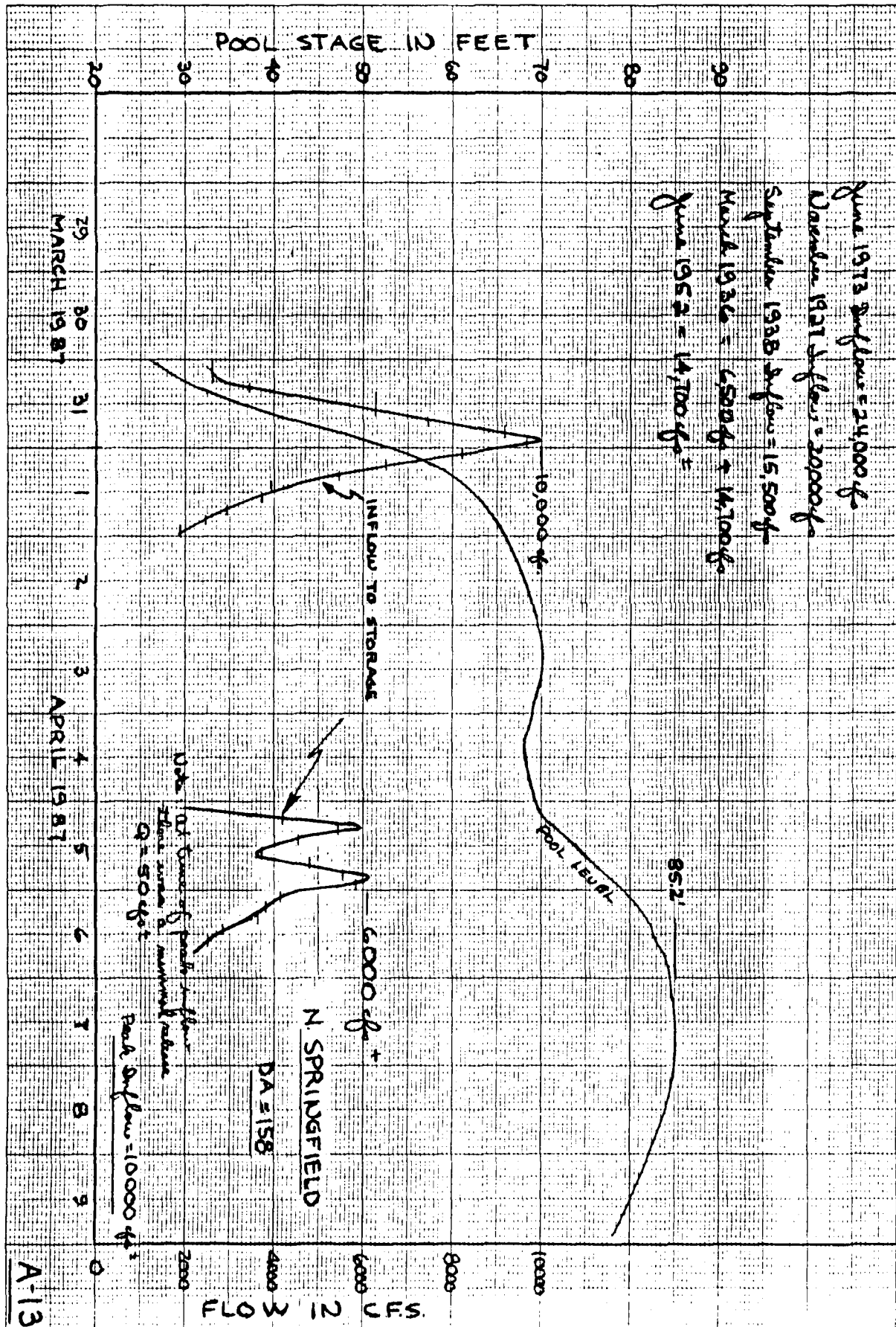


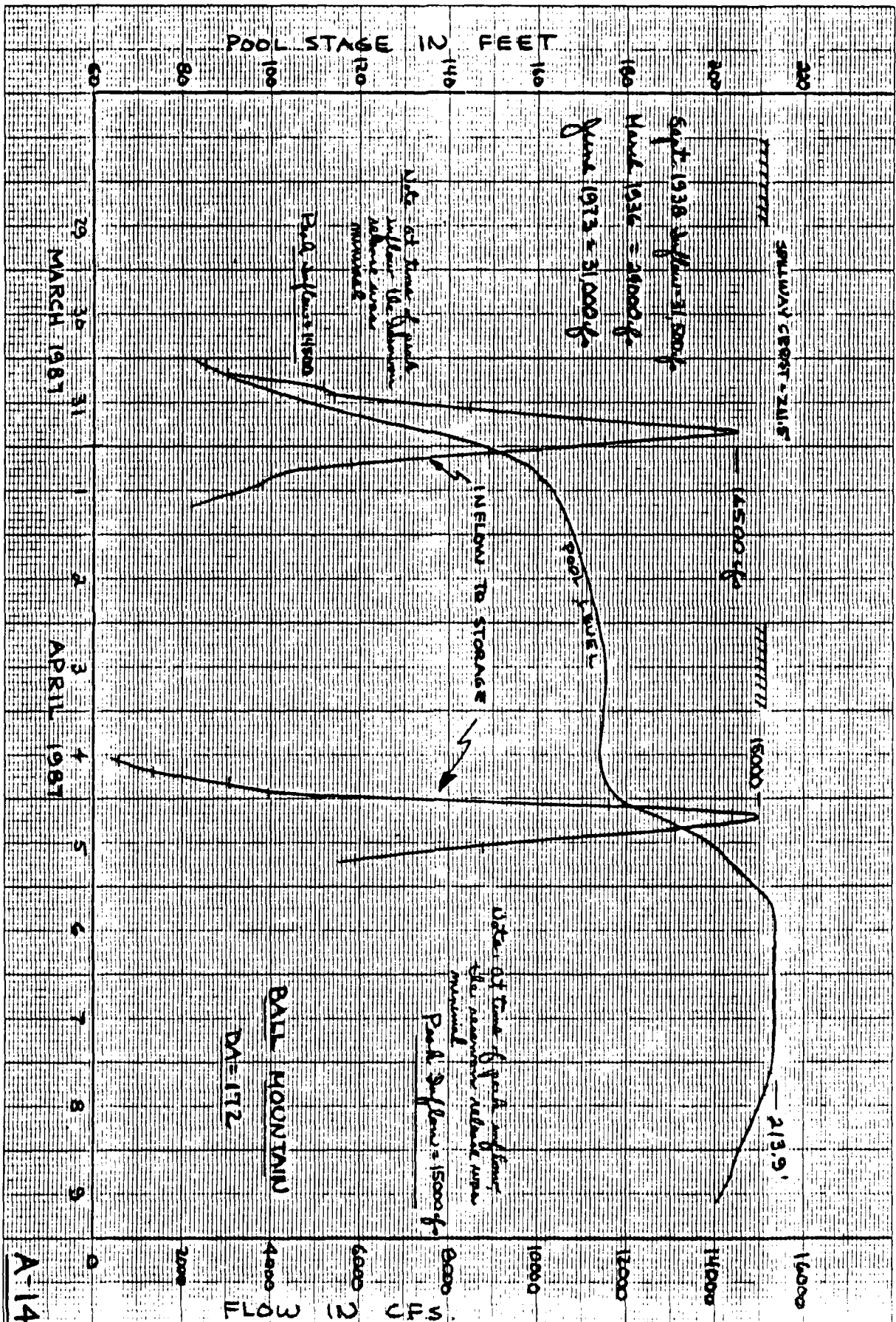


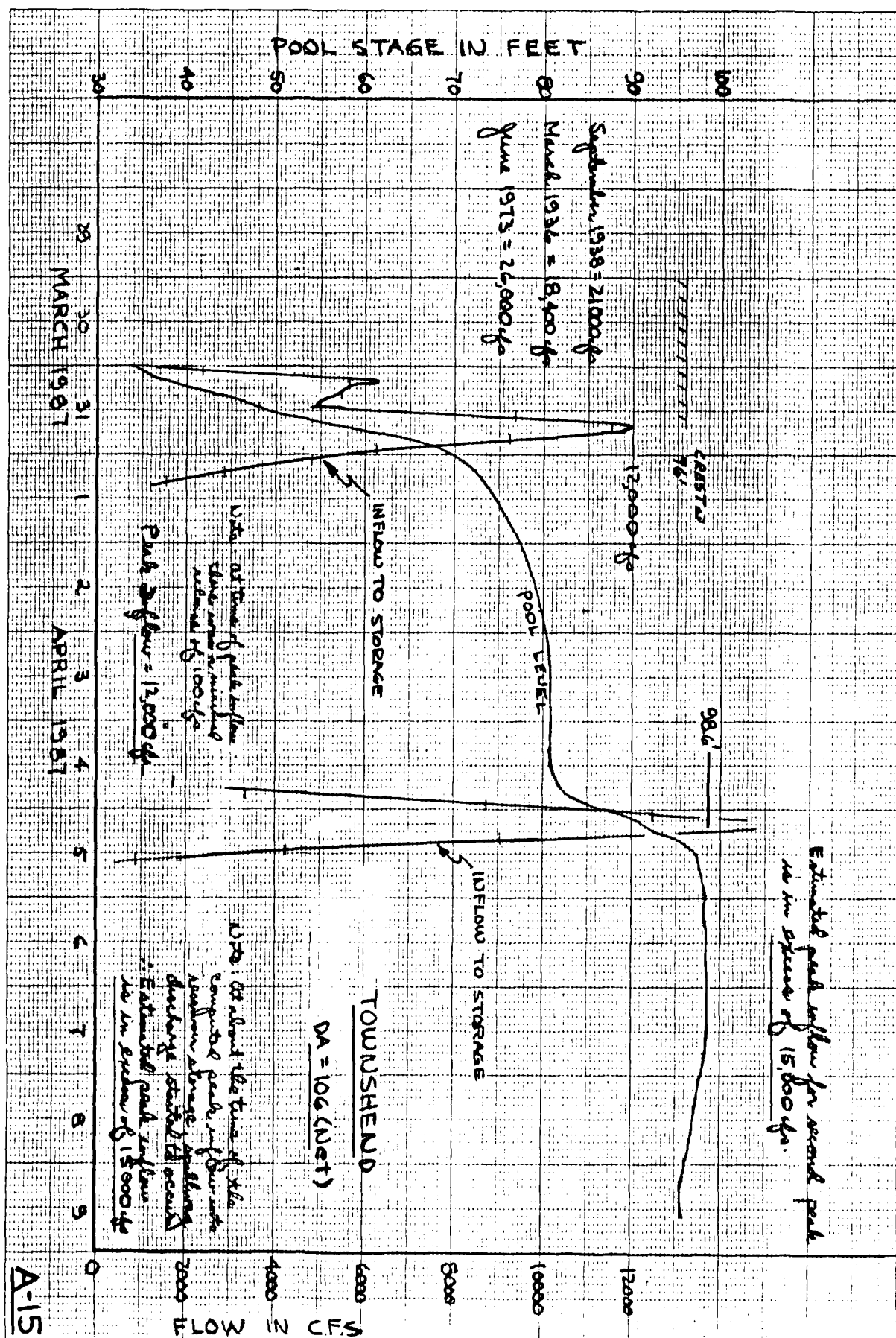


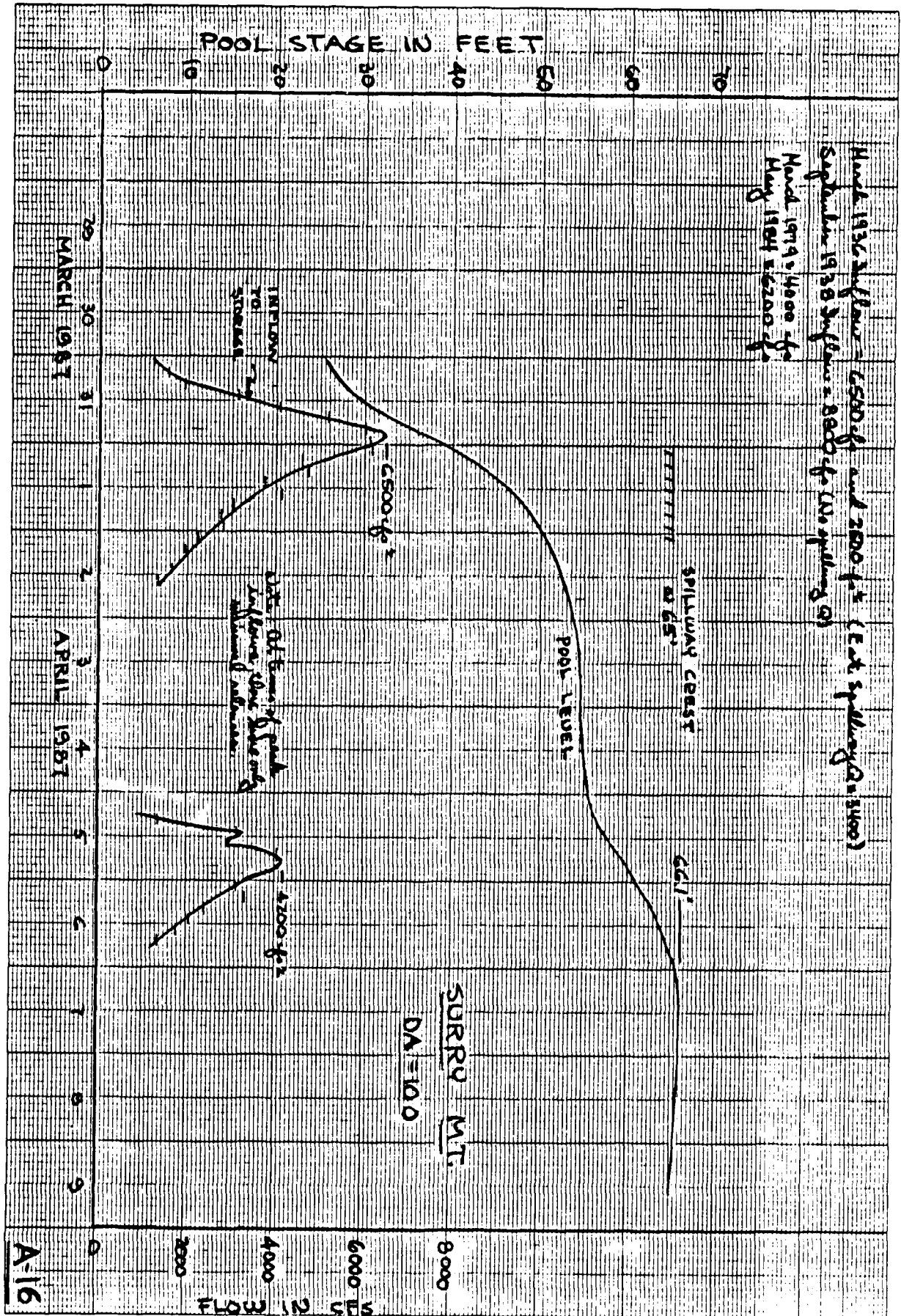




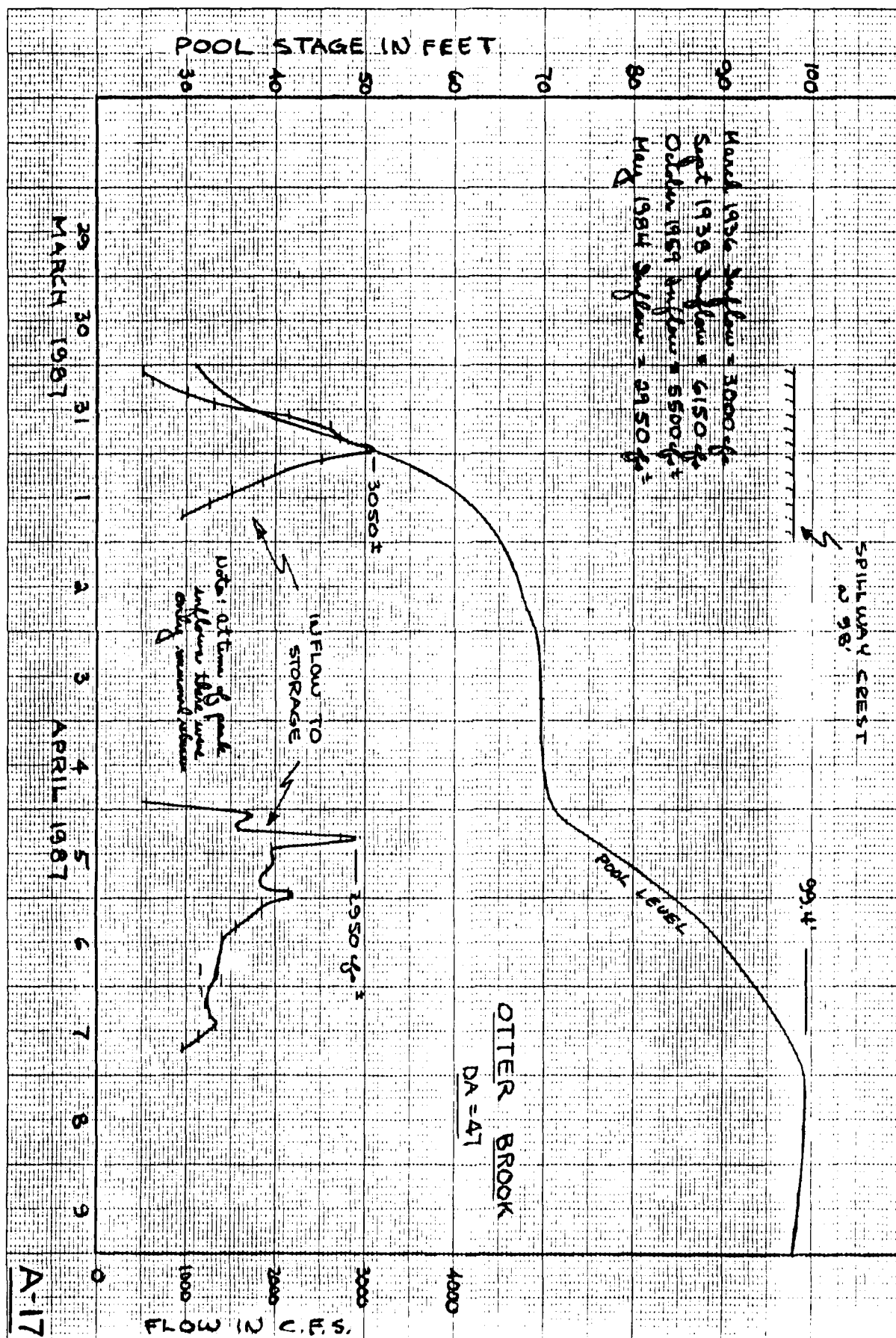




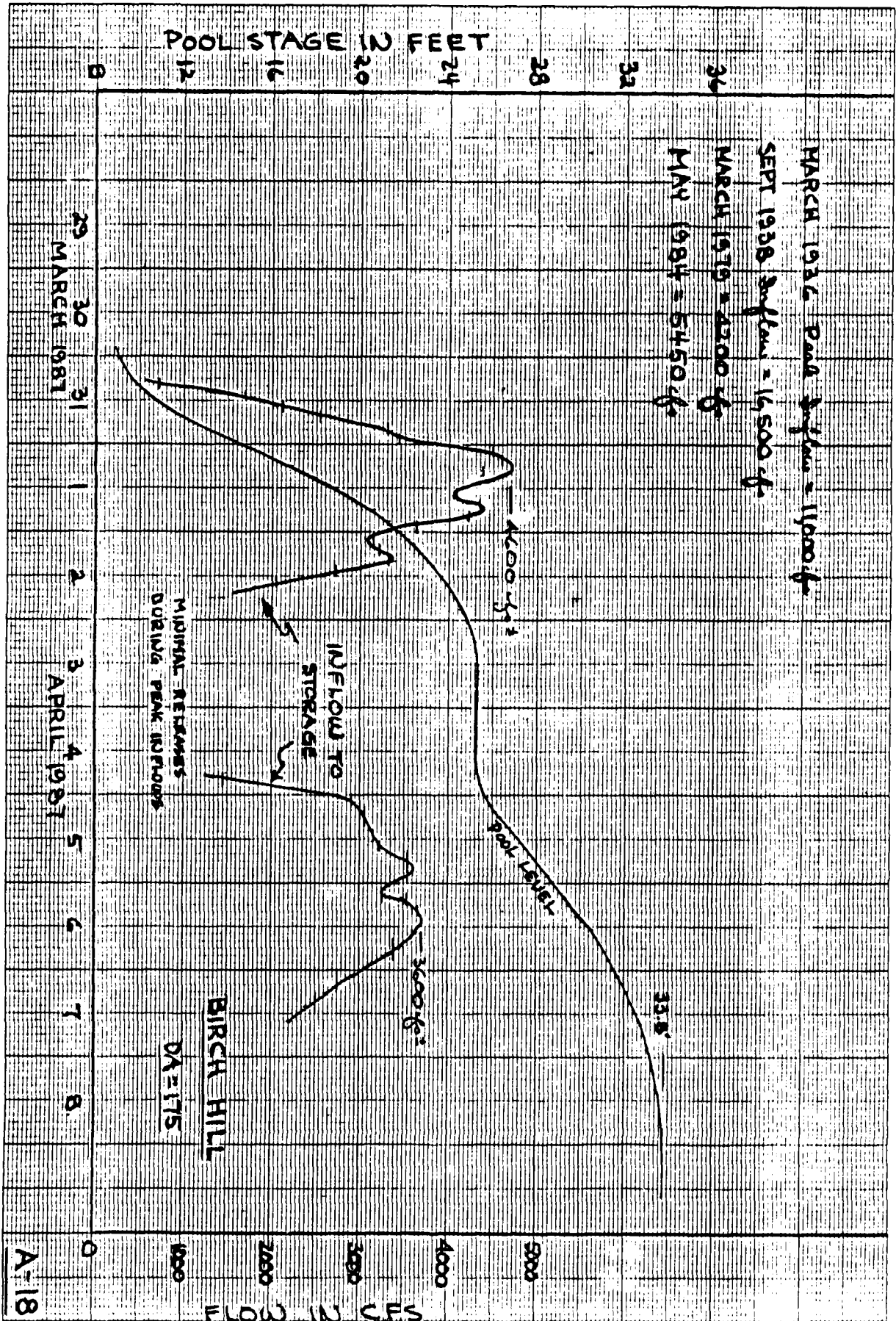


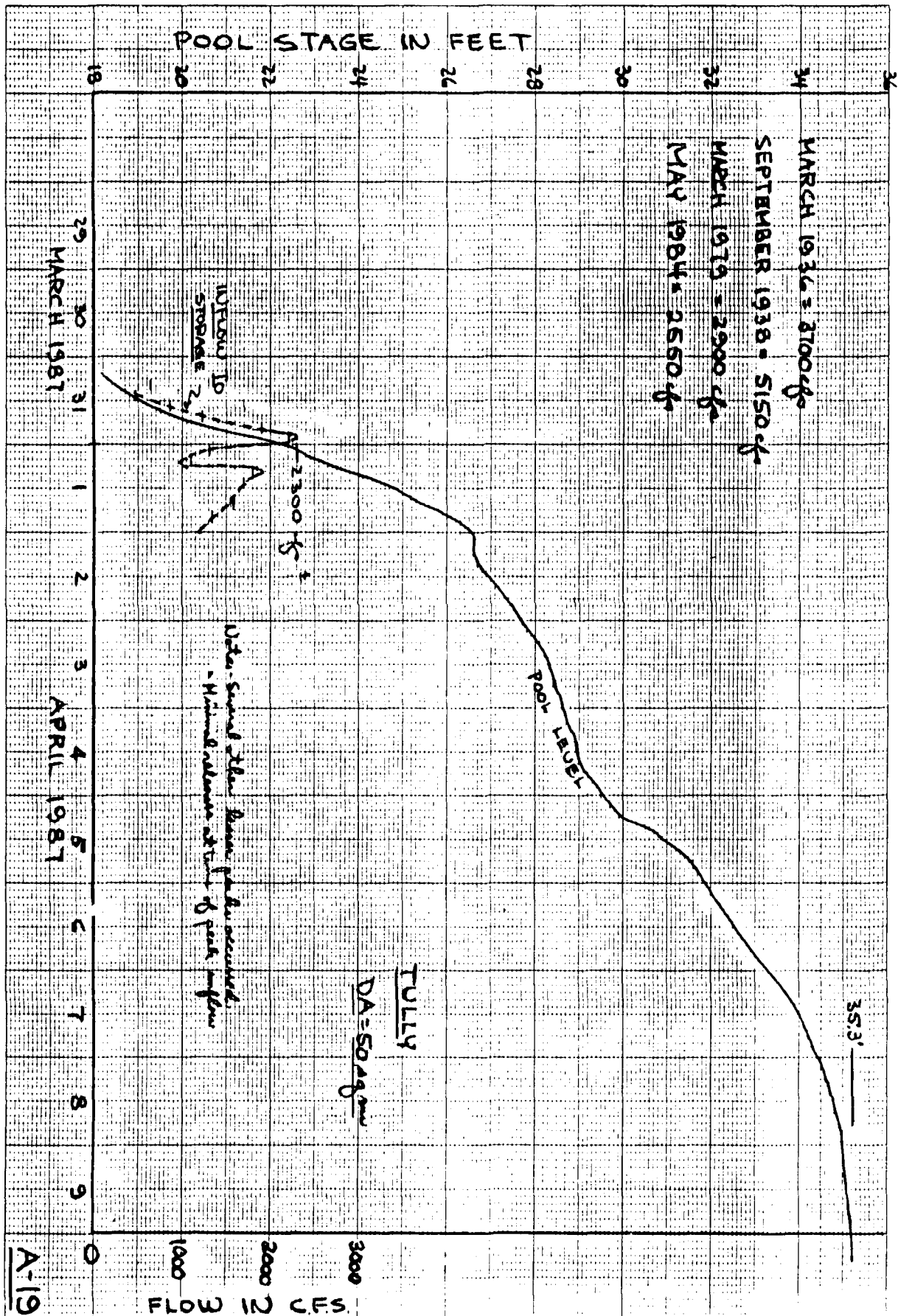


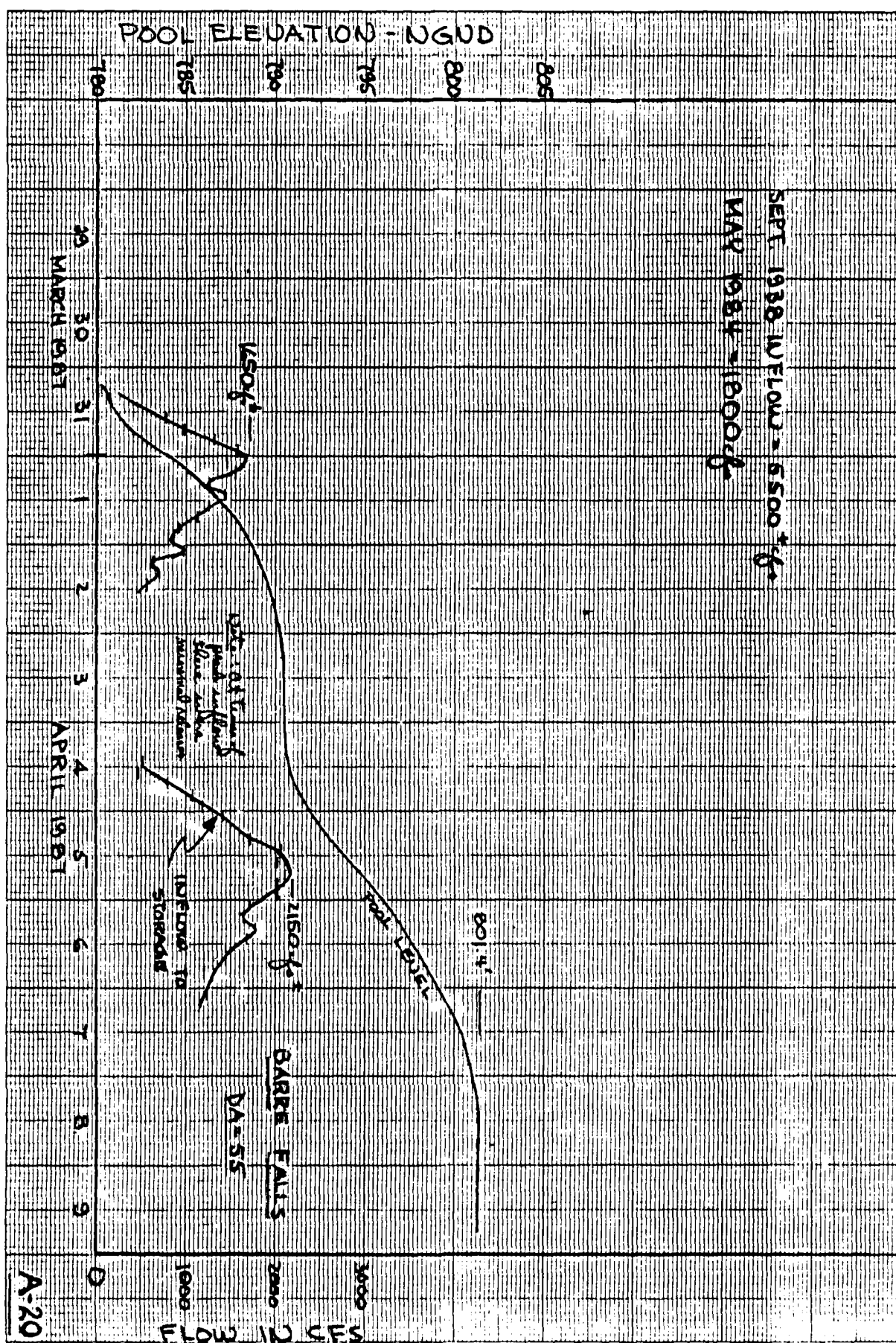
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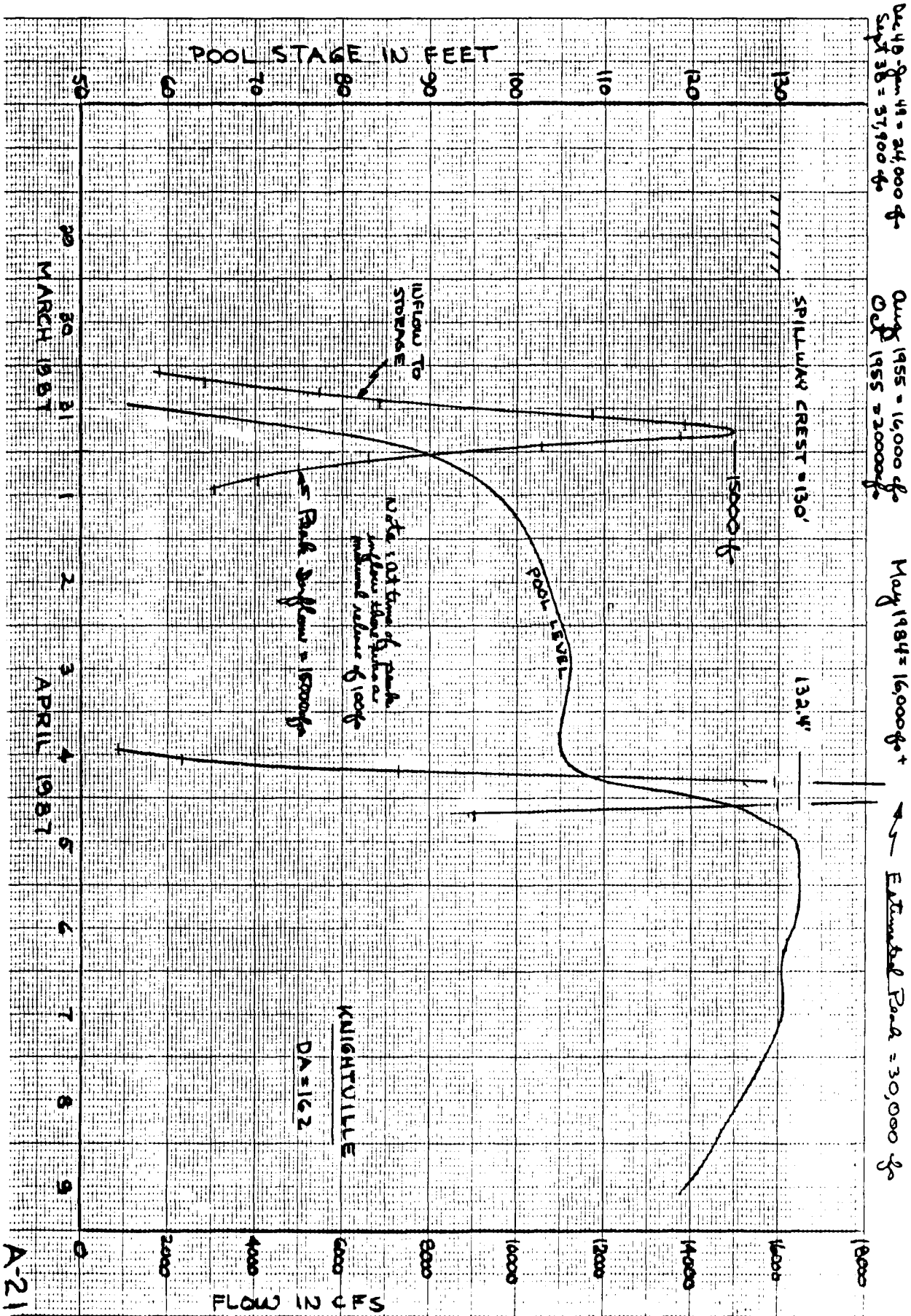


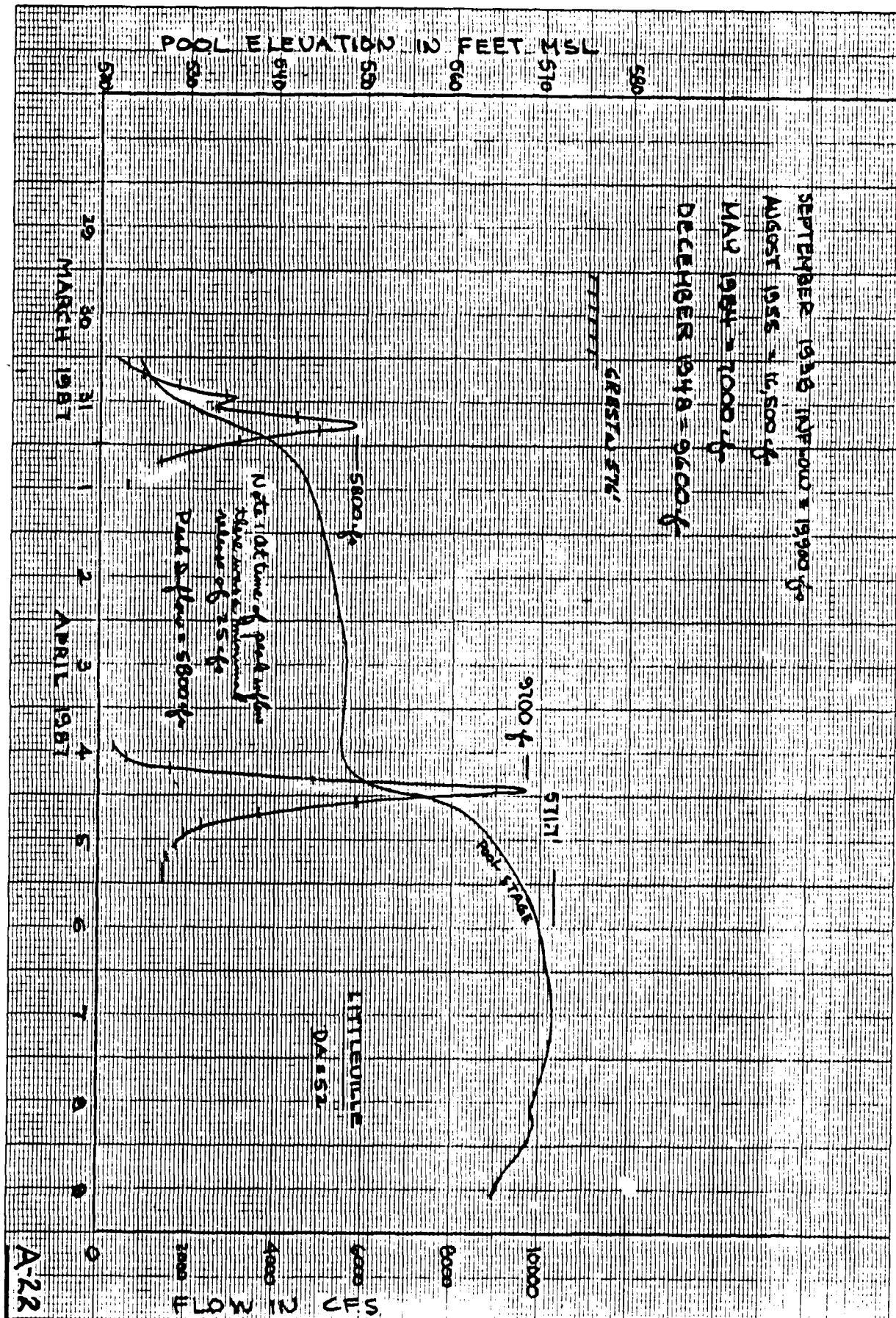
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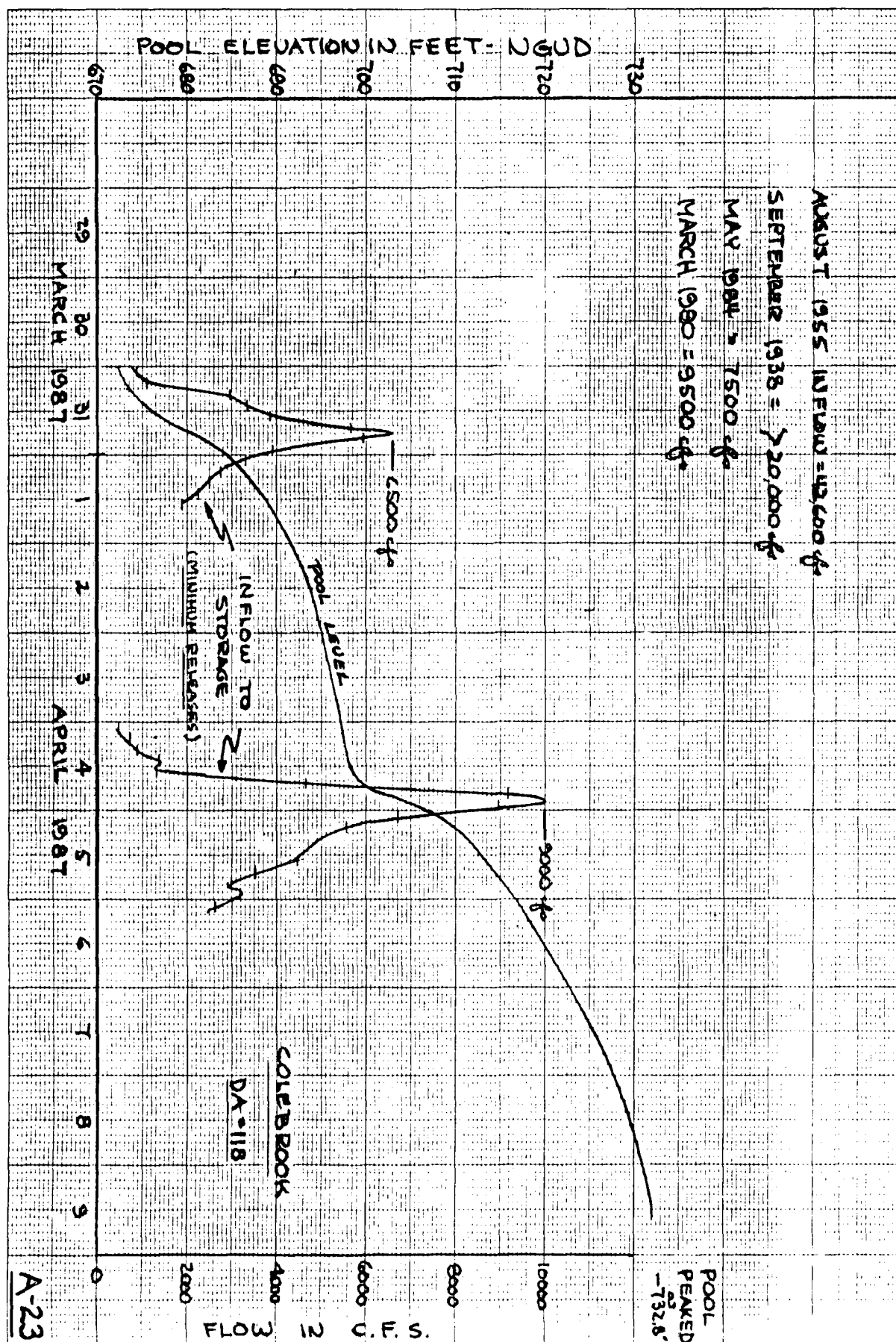




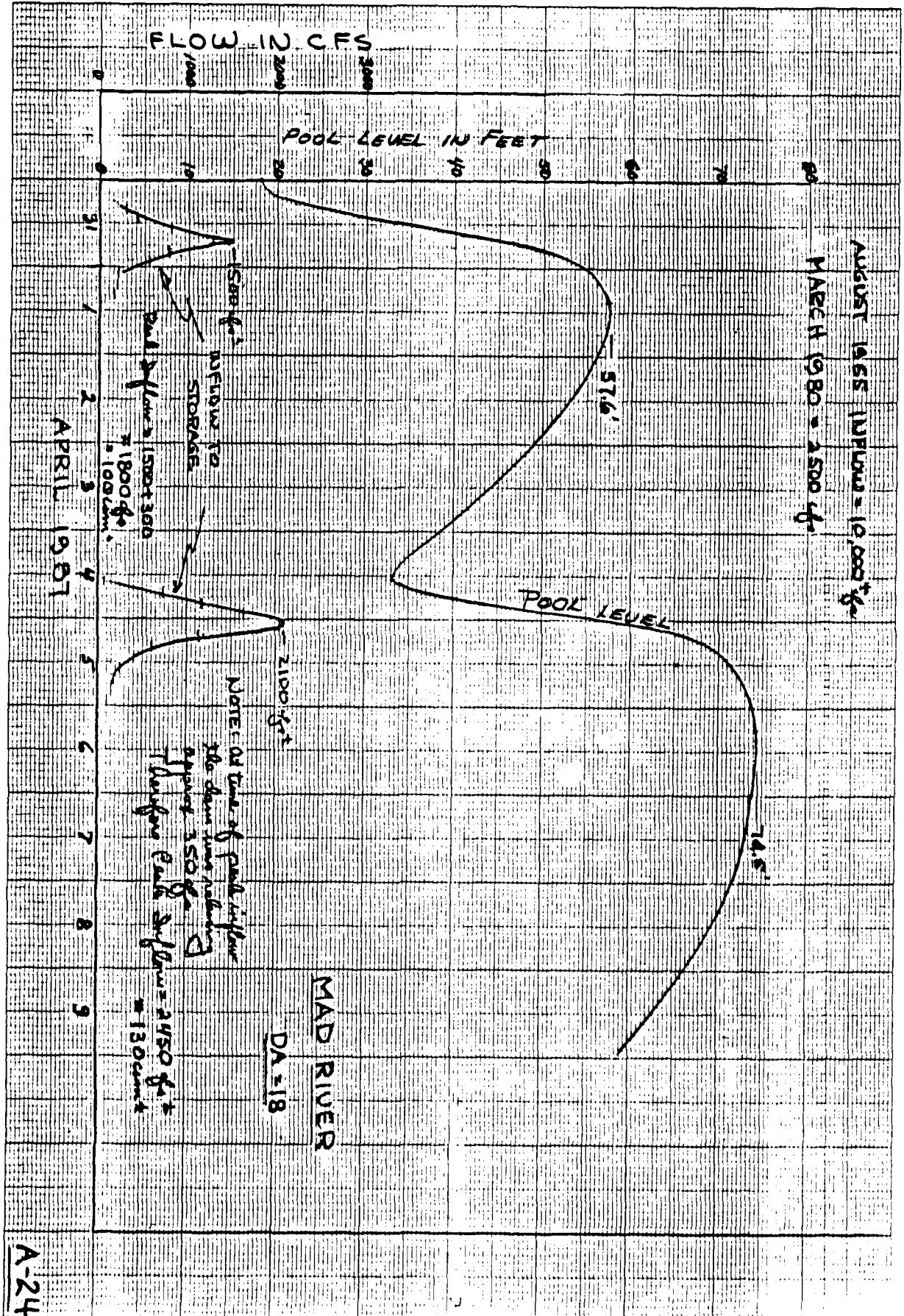








A-23



AD-A194 142 POST FLOOD REPORT MARCH/APRIL 1987(U) CORPS OF
ENGINEERS WALTHAM MA NEW ENGLAND DIV APR 87

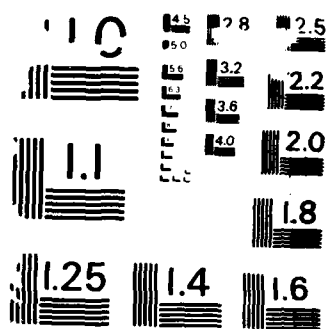
2/2

UNCLASSIFIED

F/G 8/8

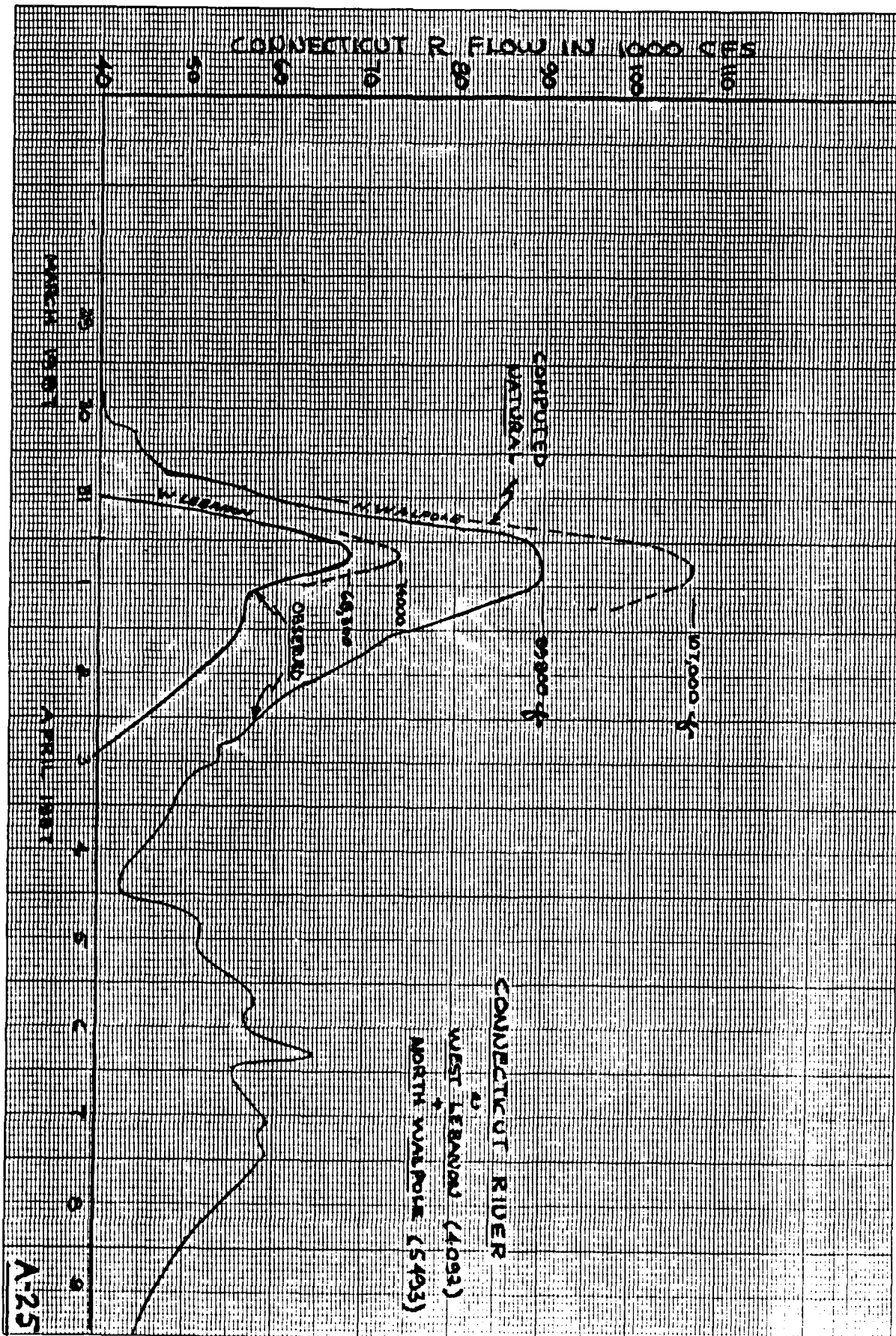
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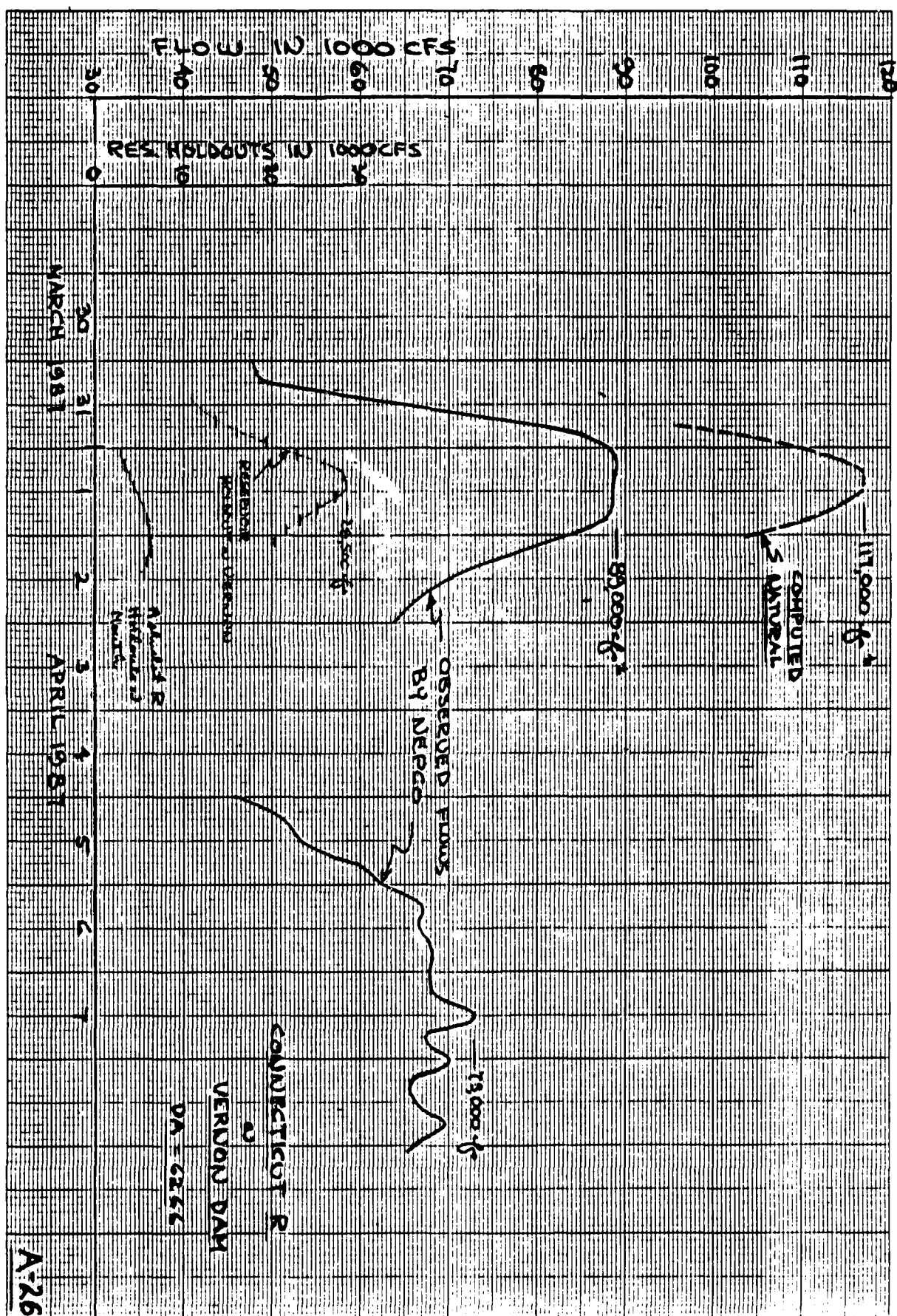


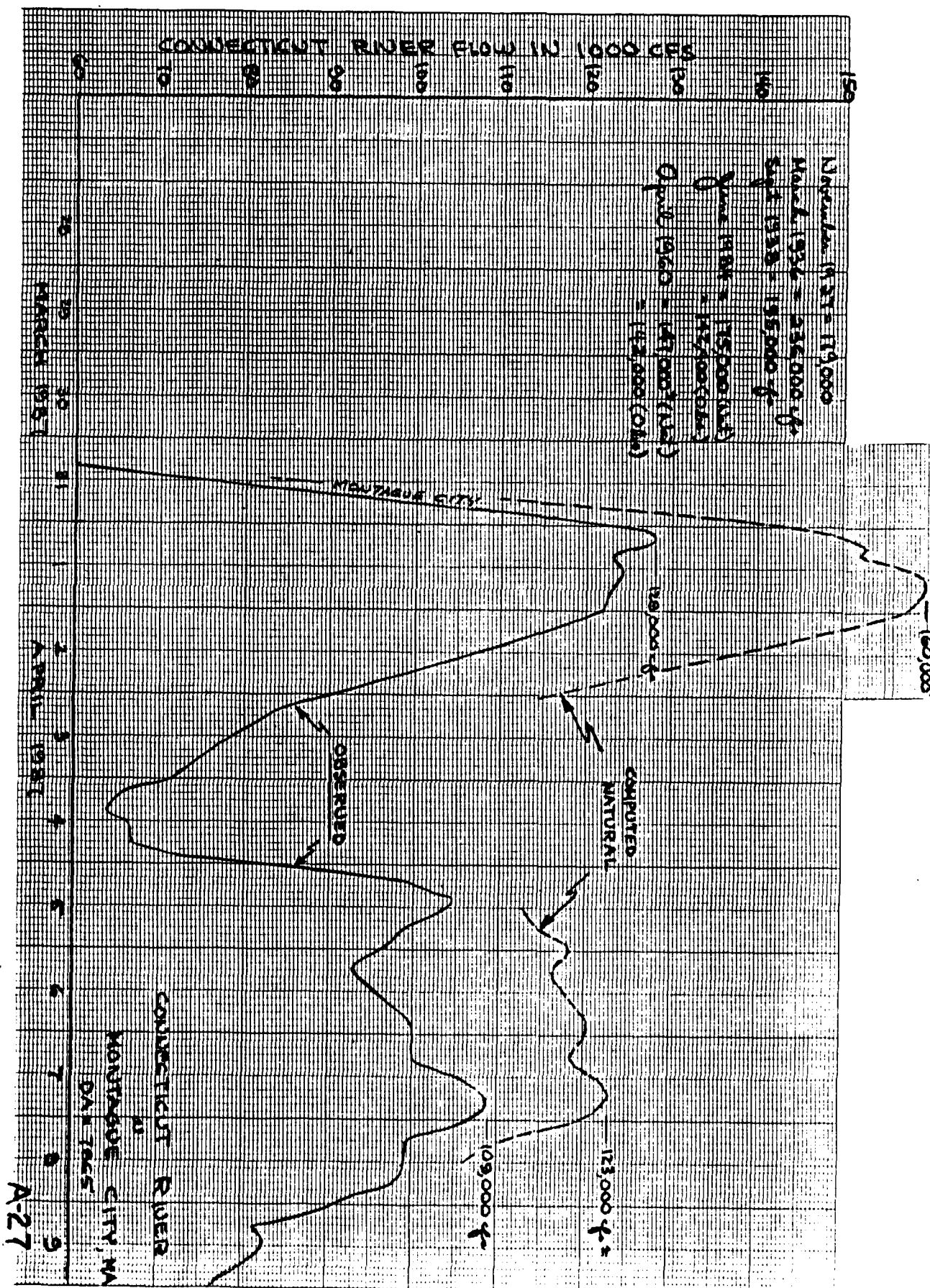


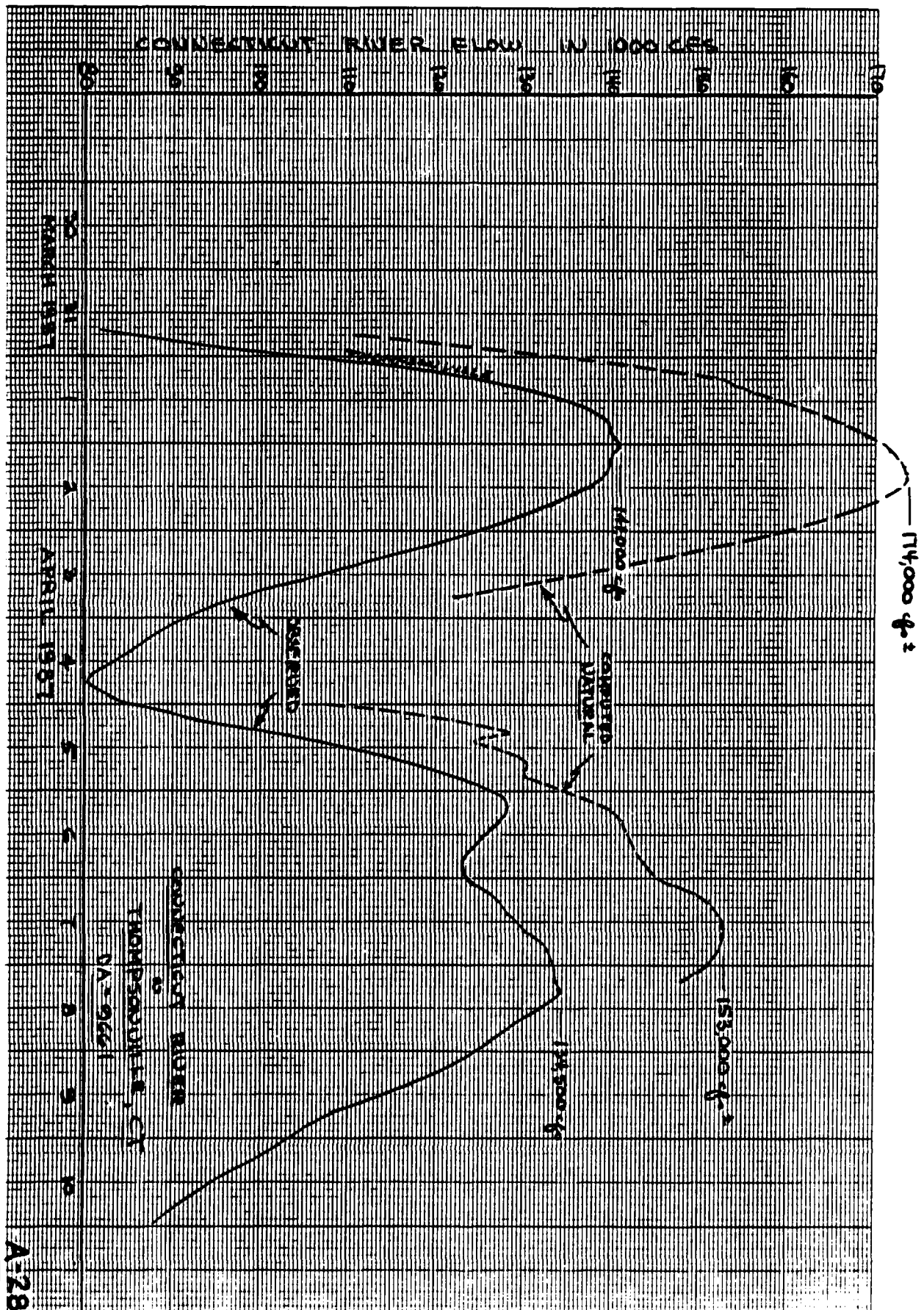
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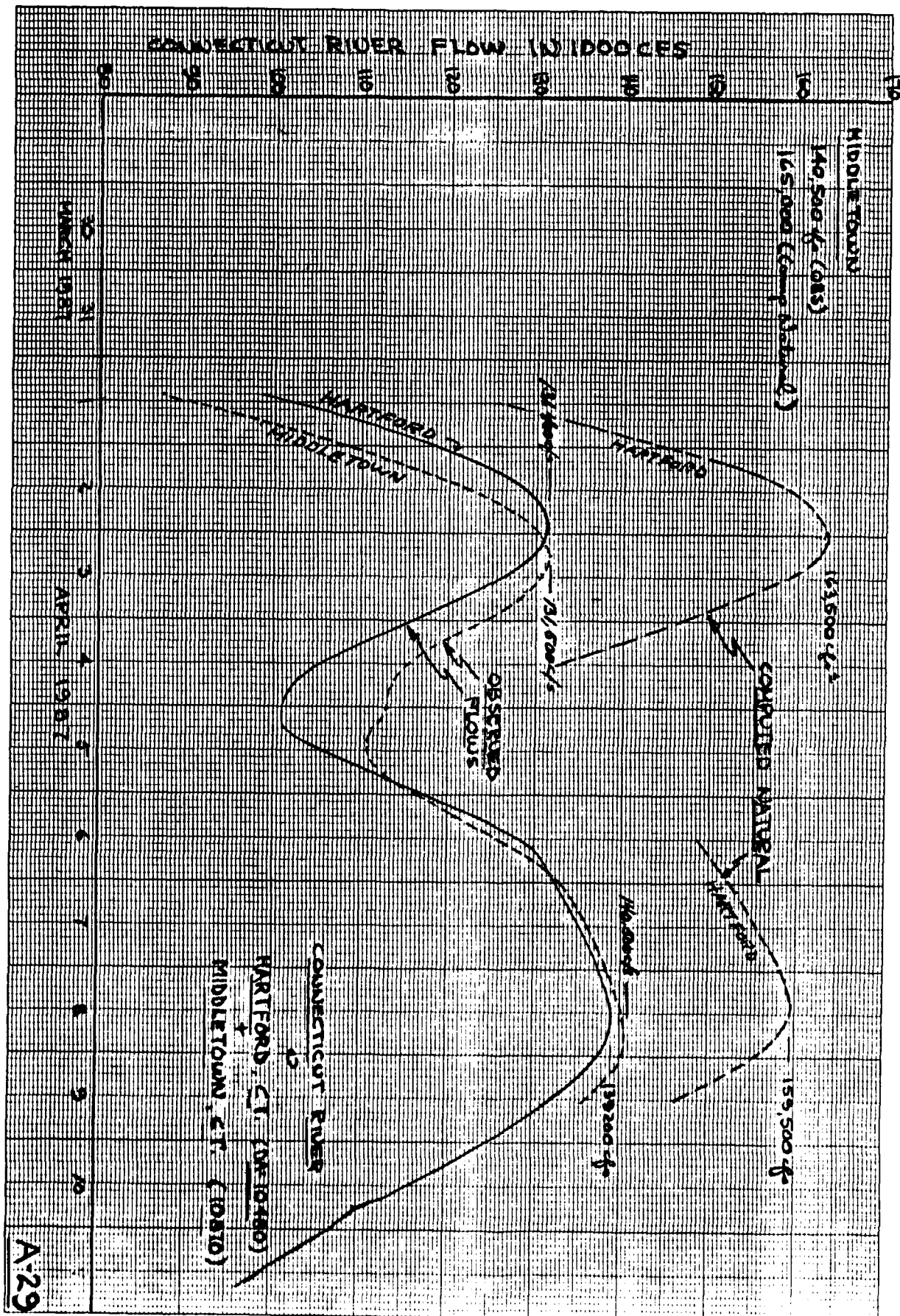
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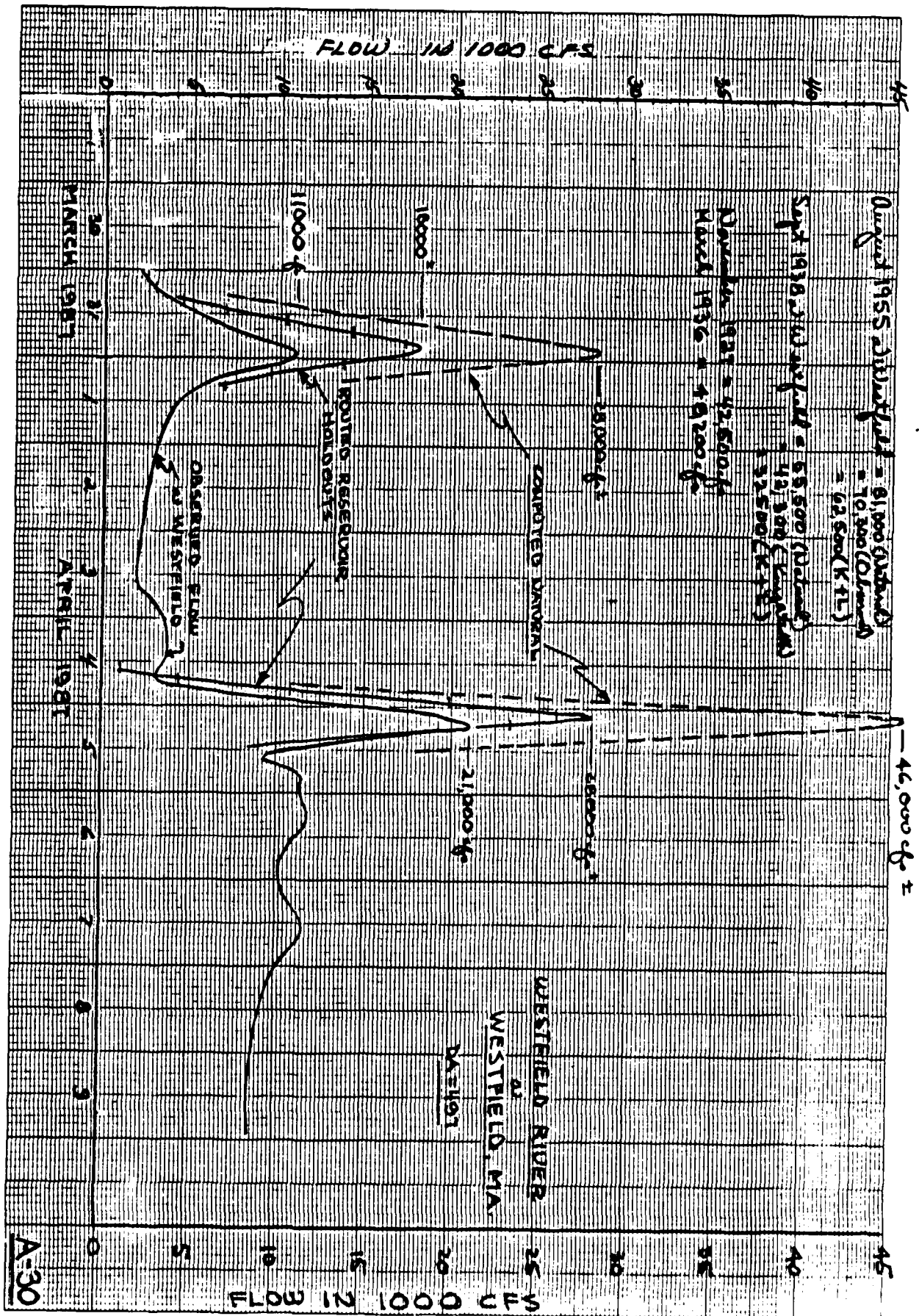


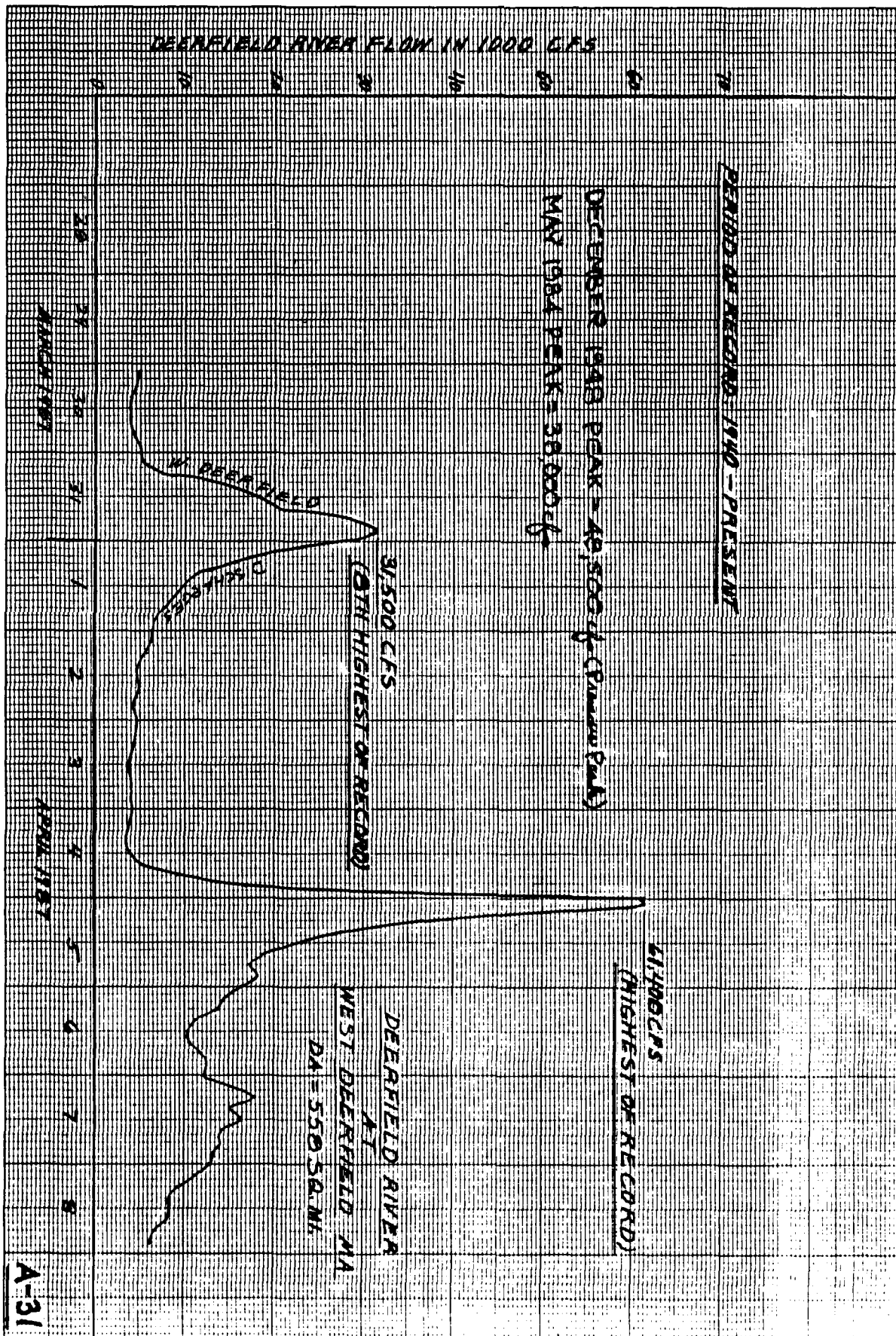




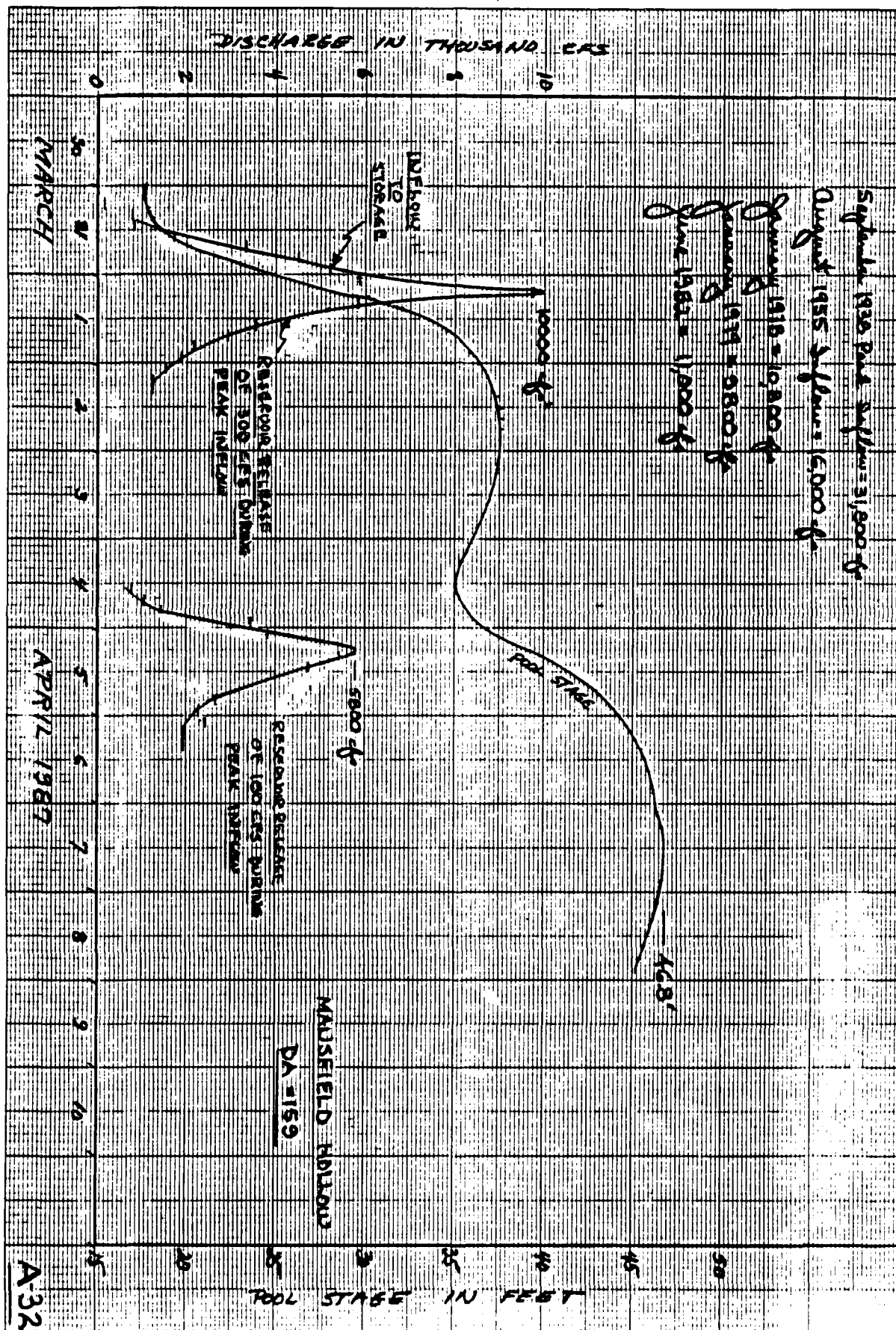


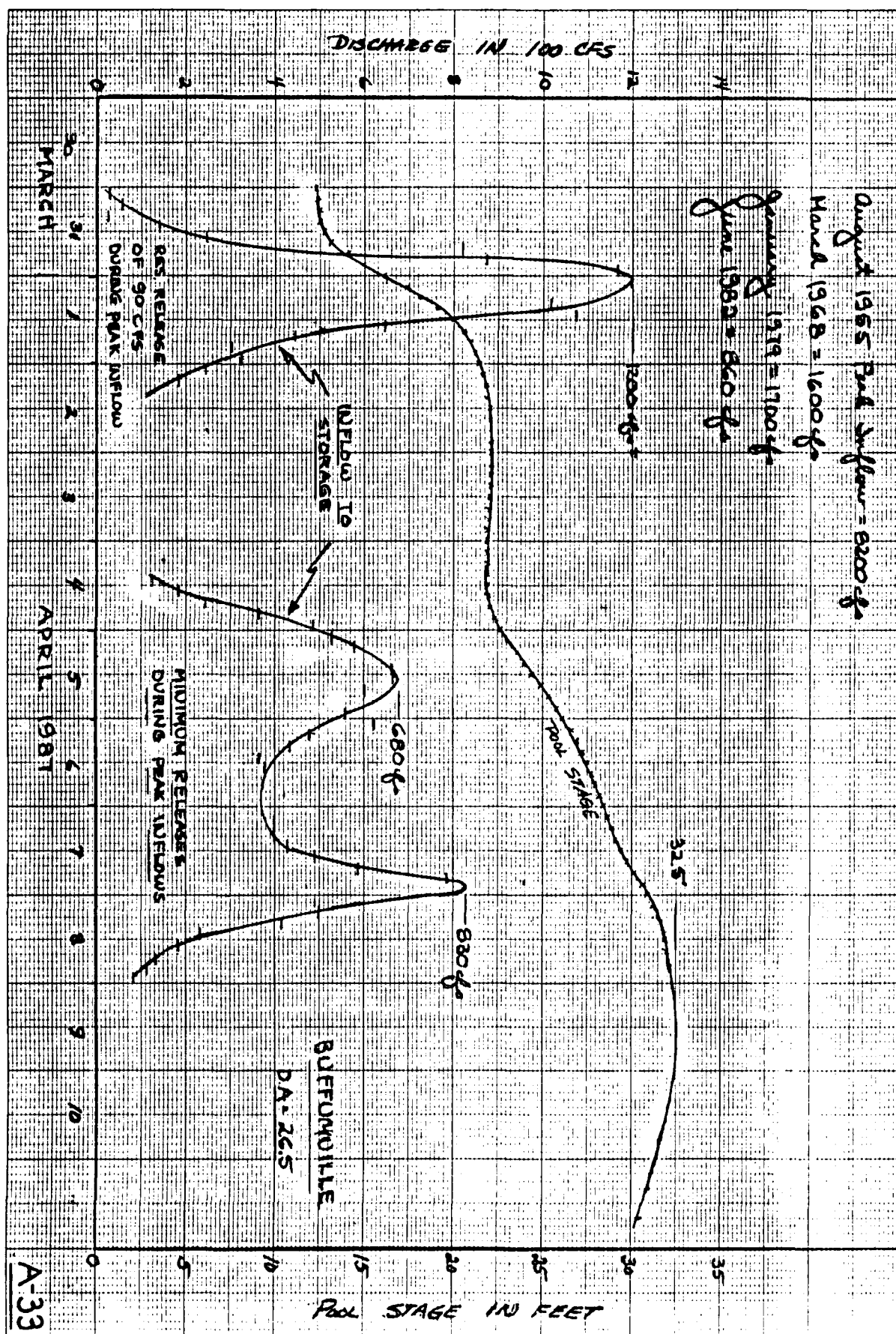
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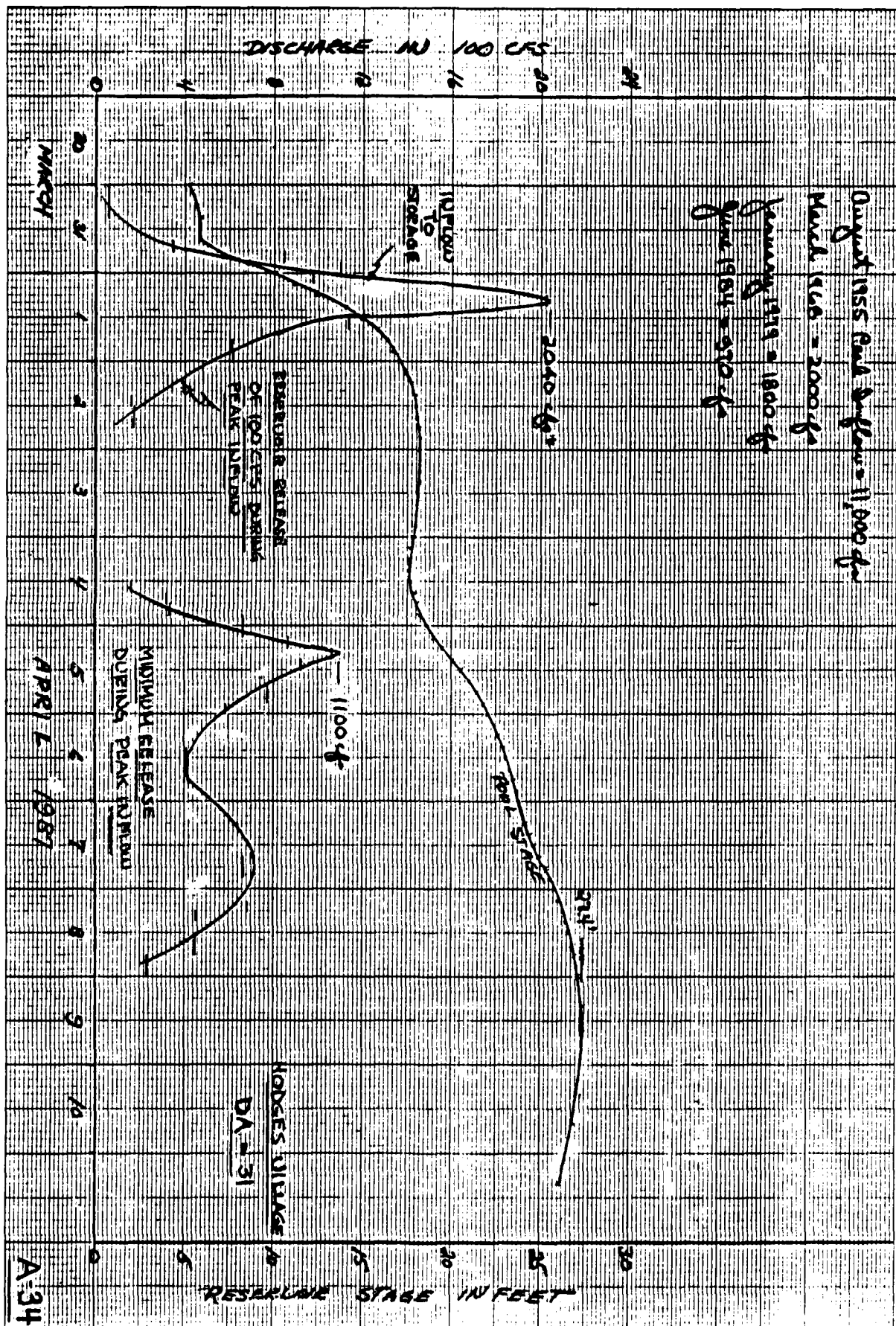


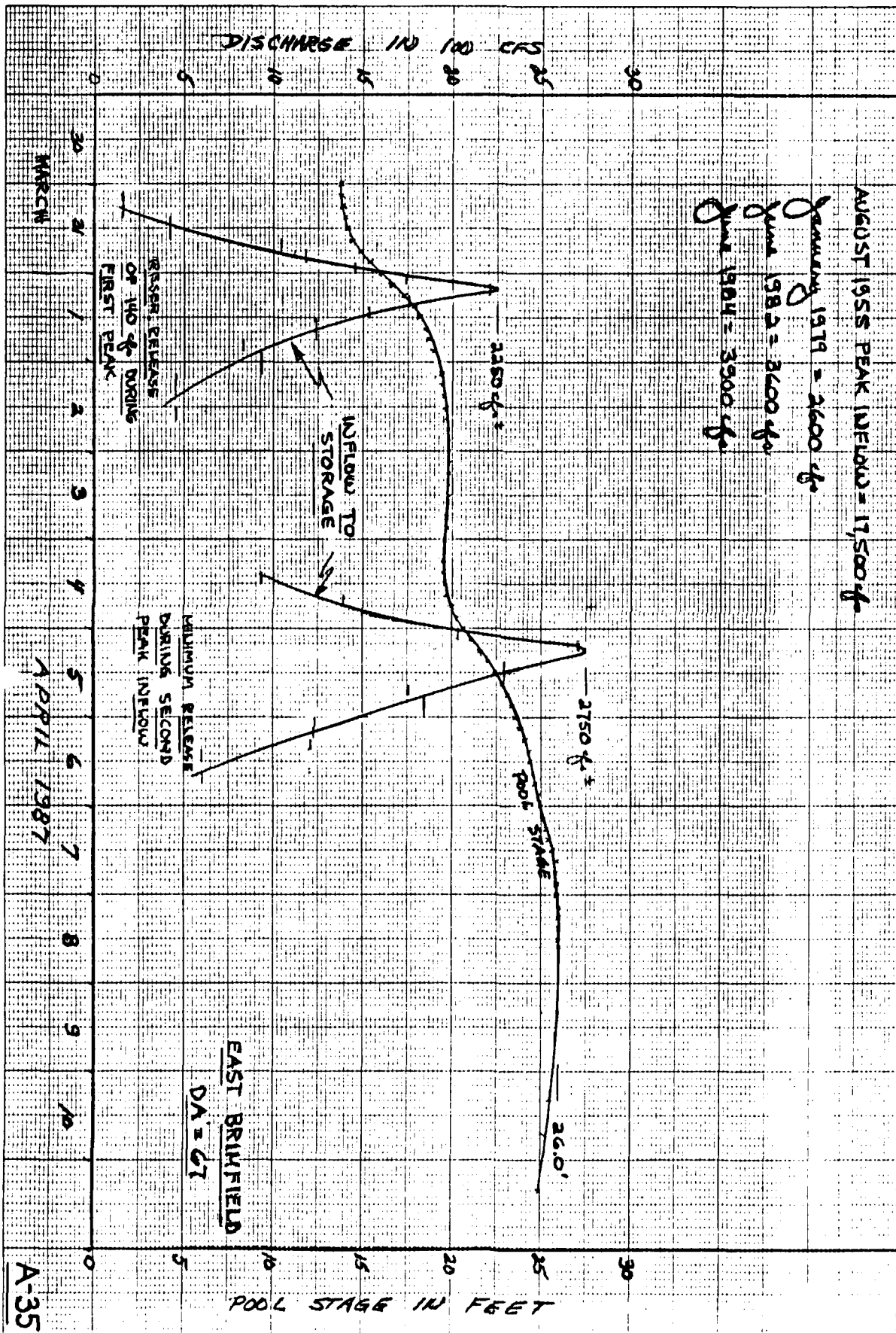


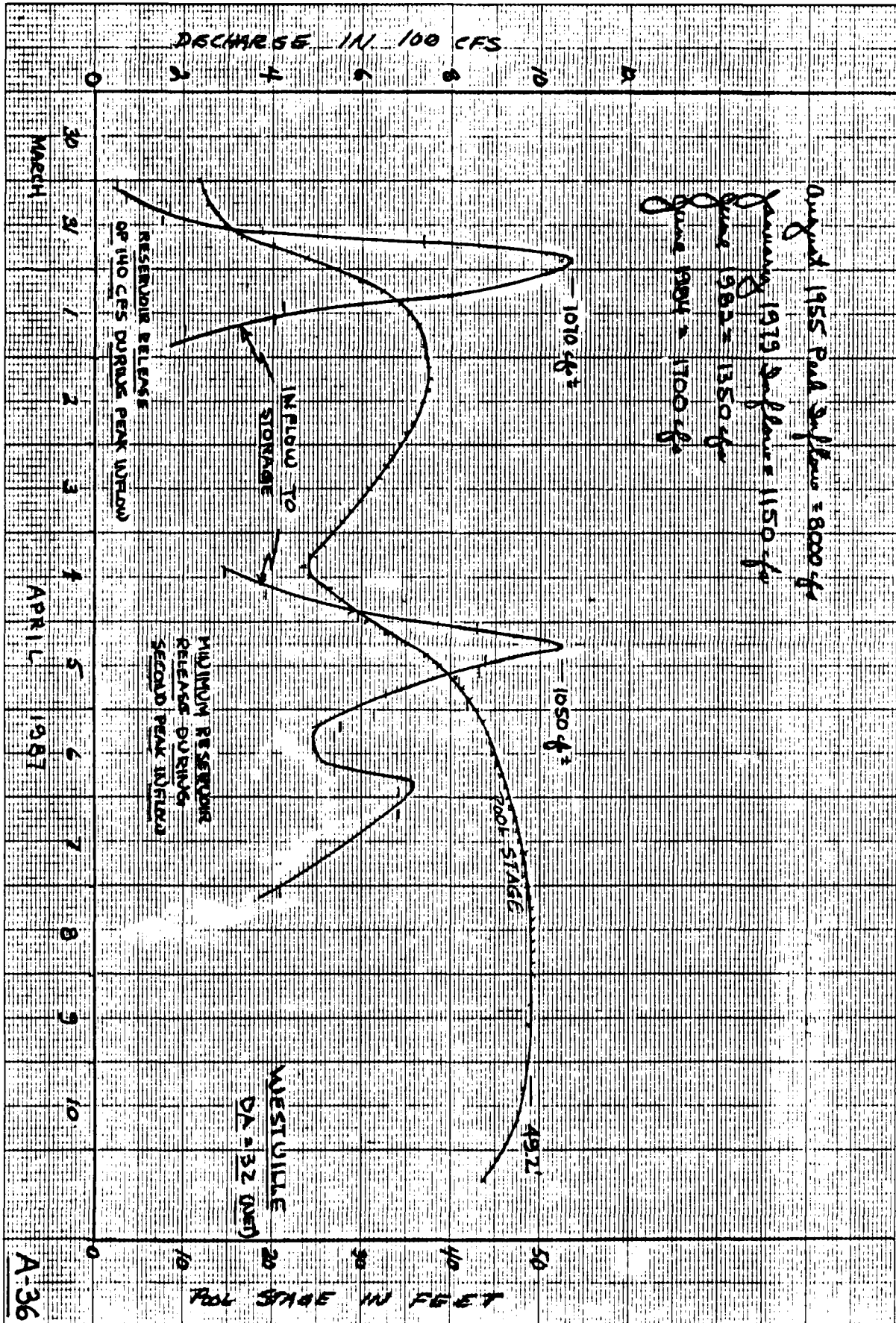
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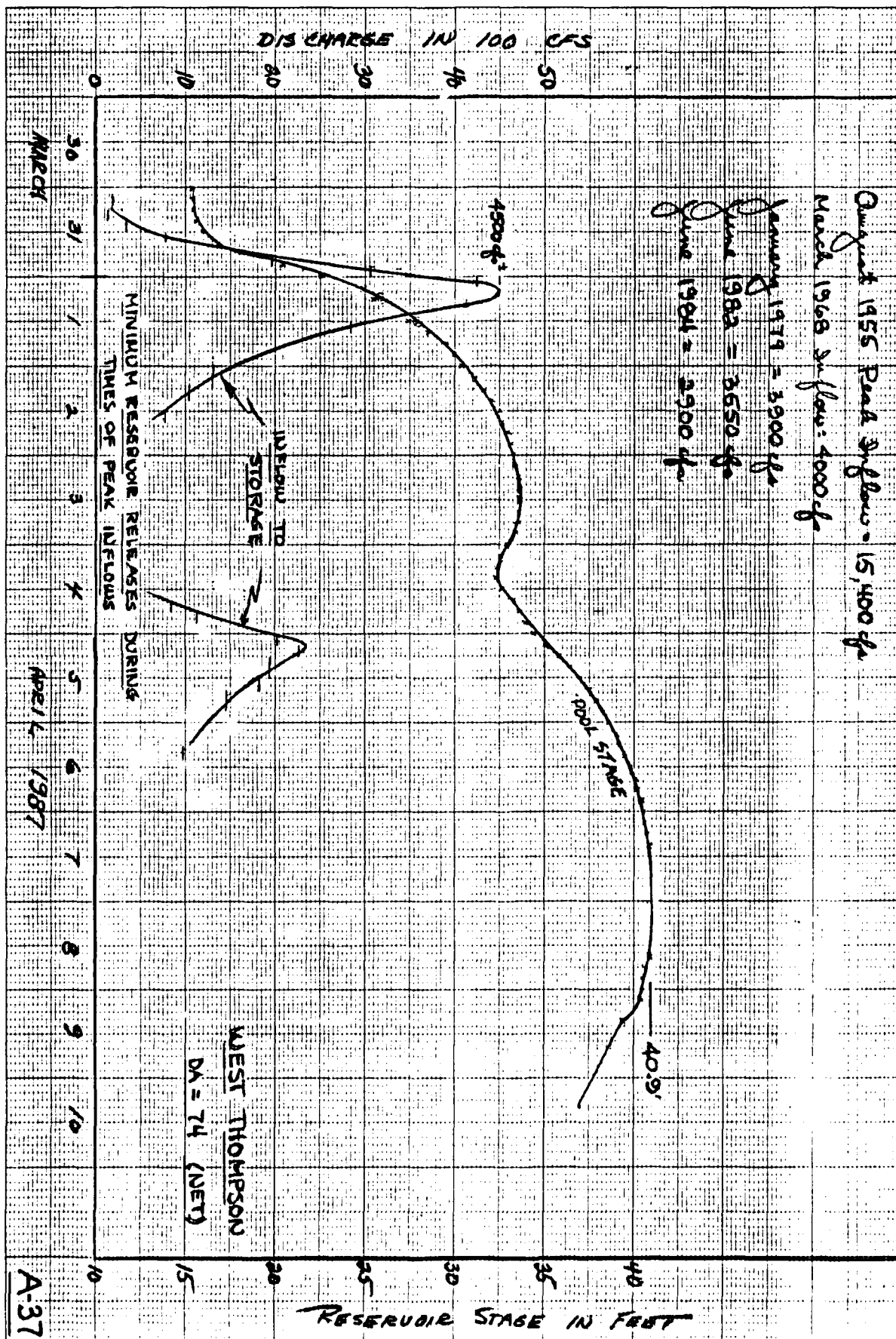




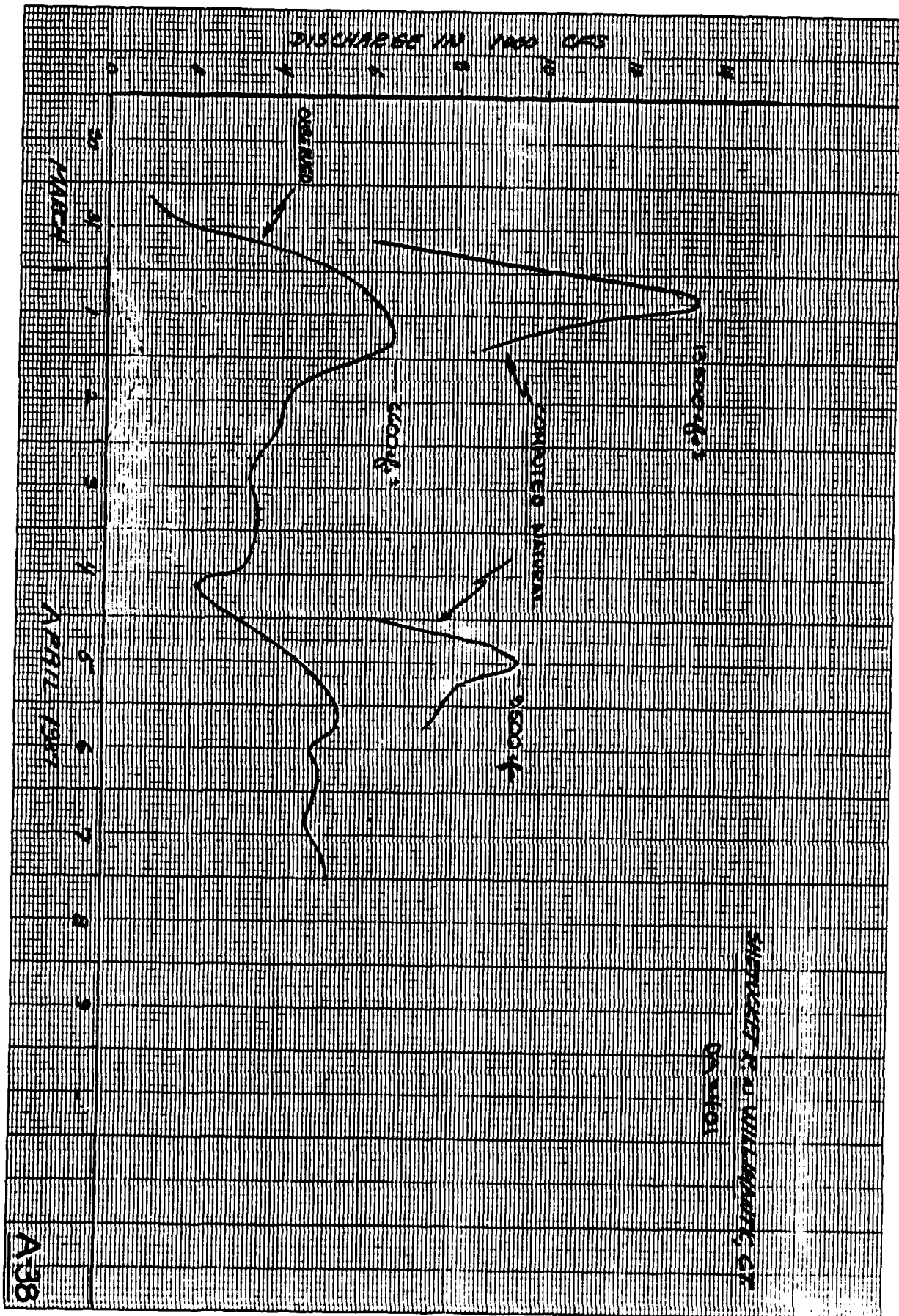








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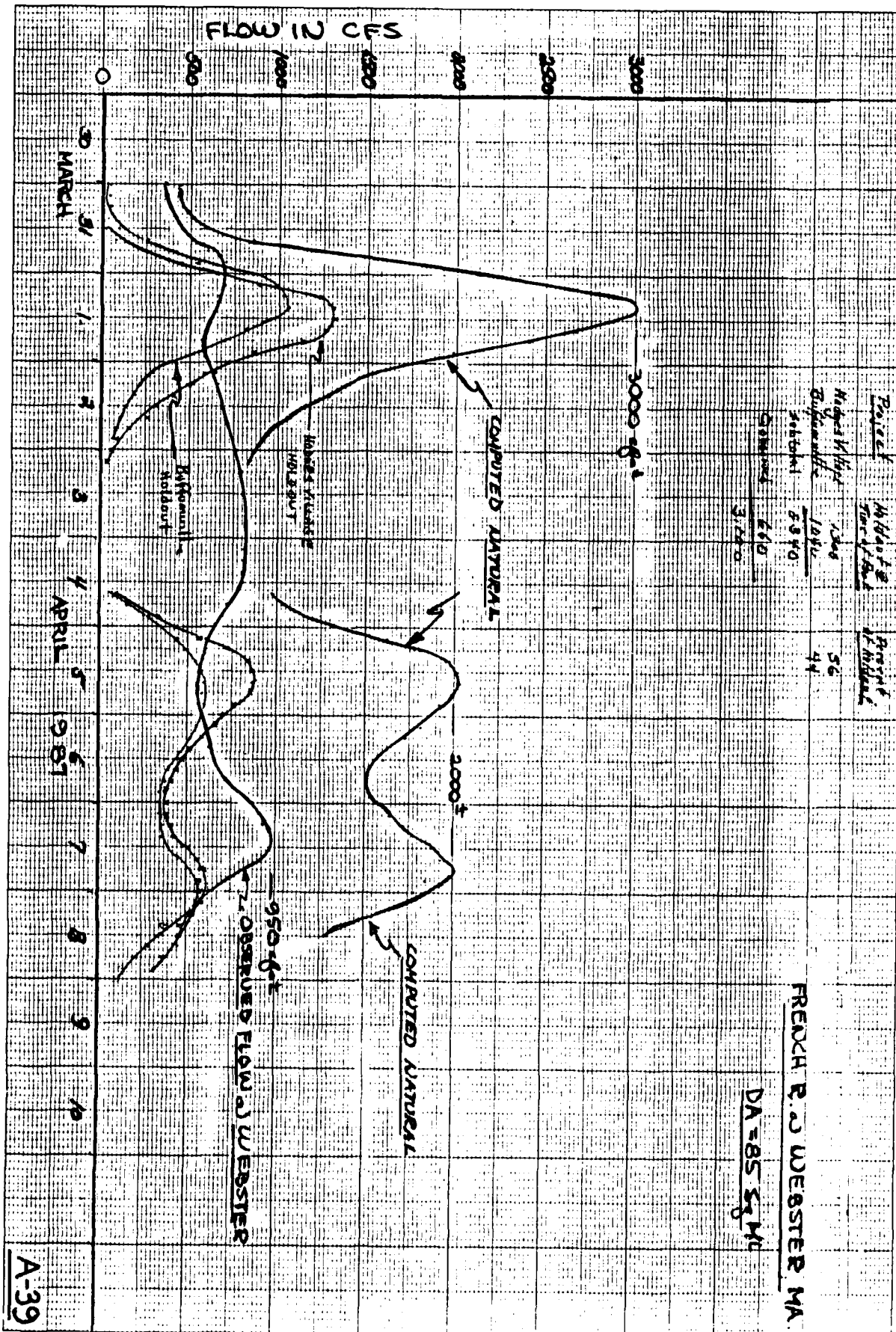


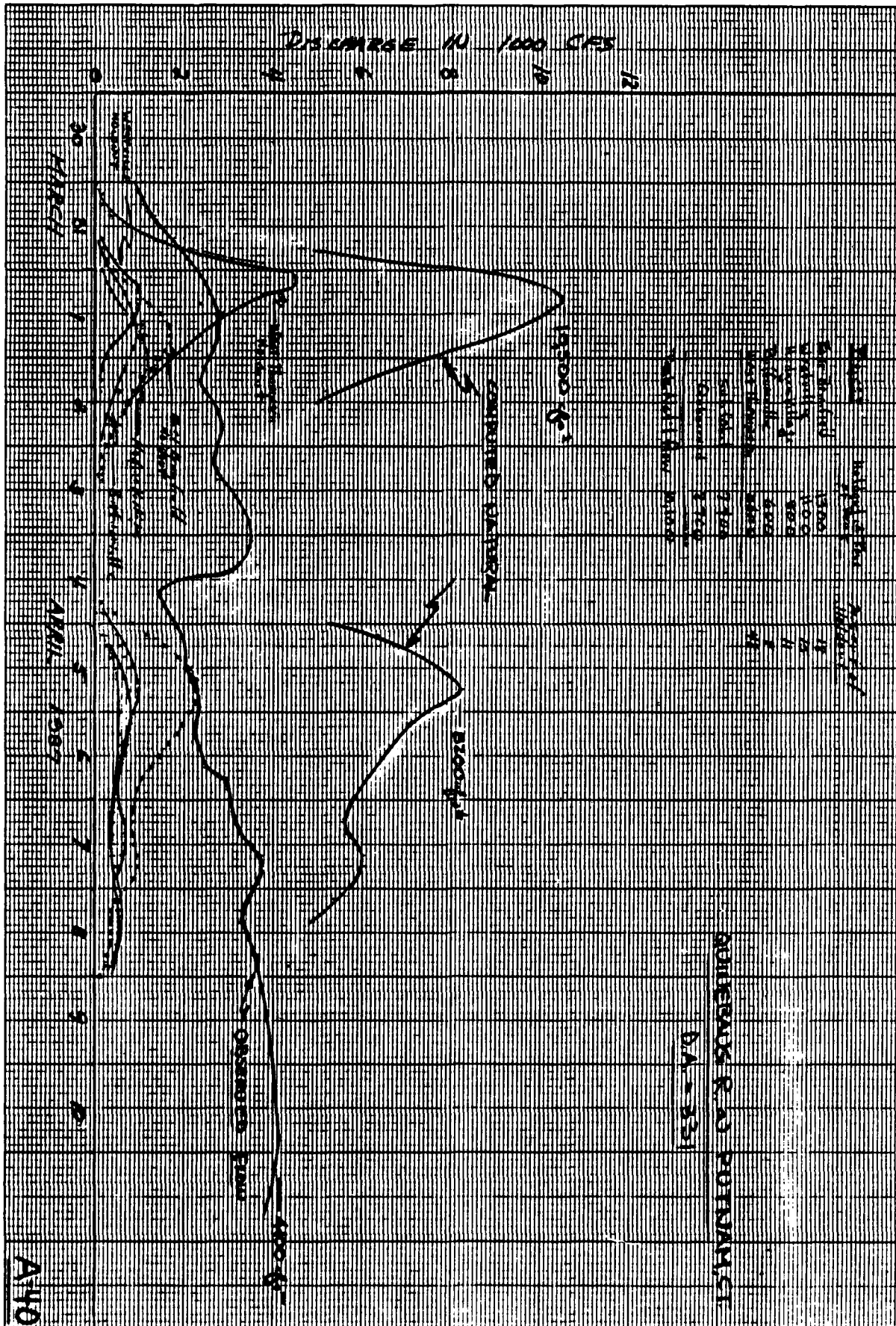
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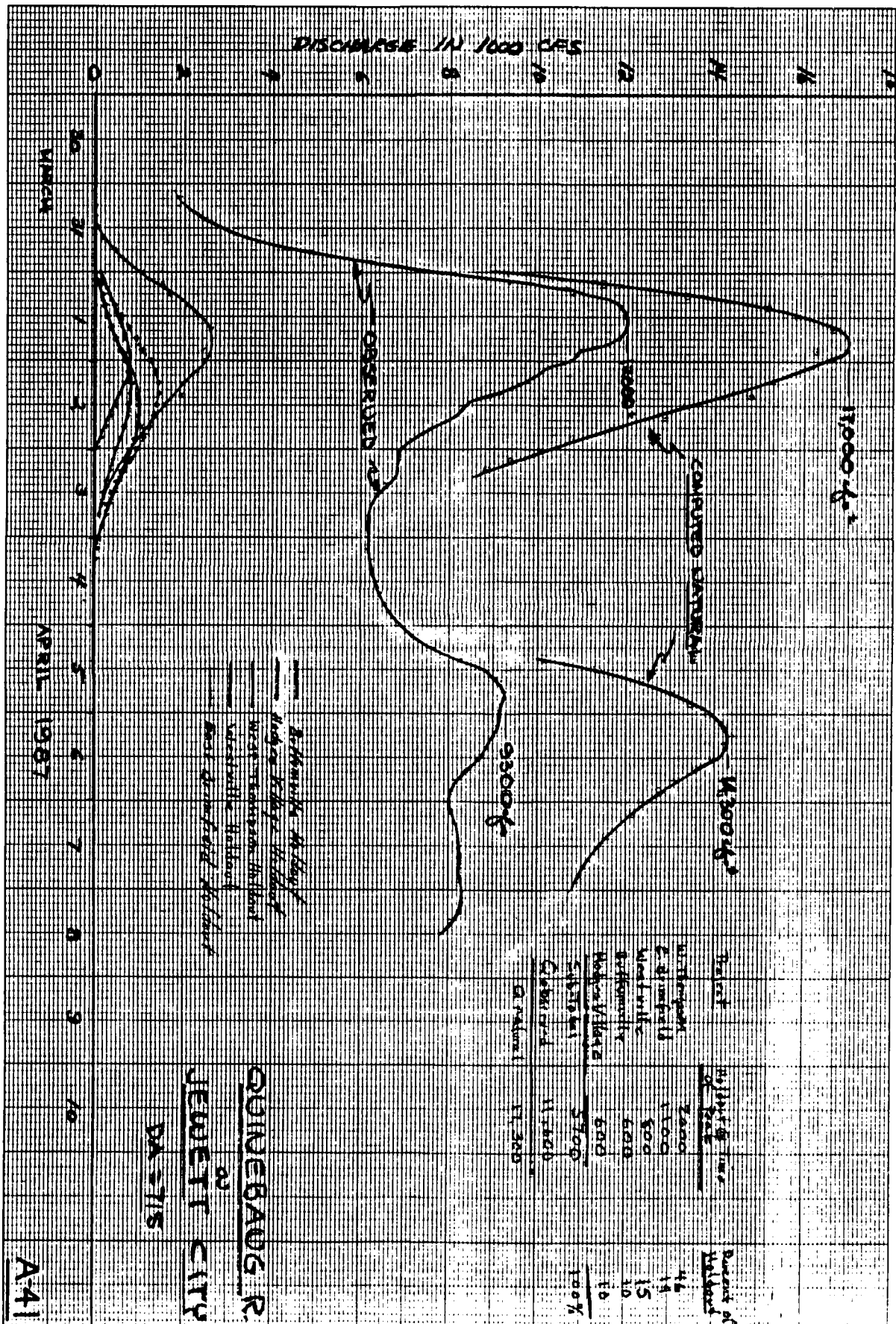
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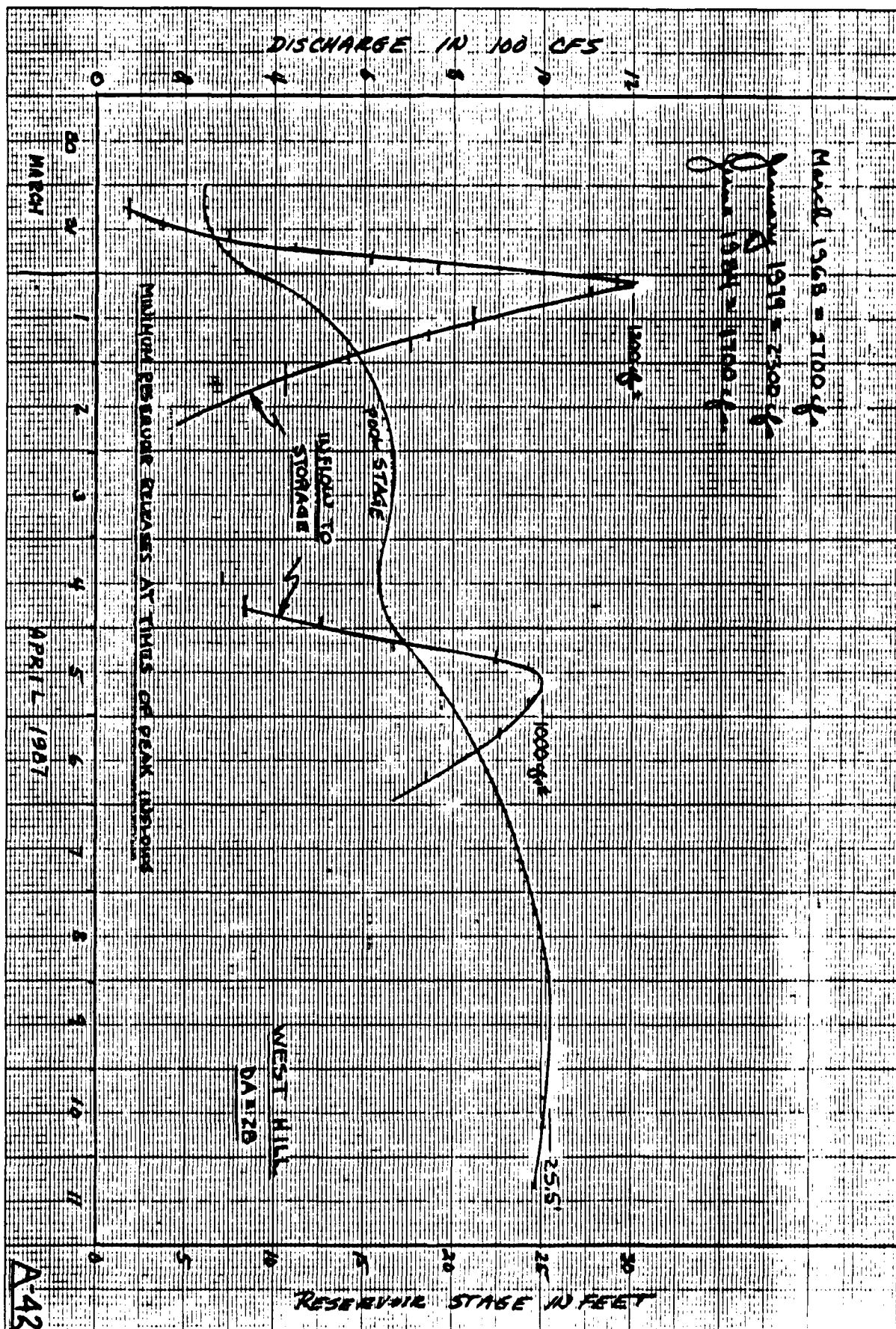
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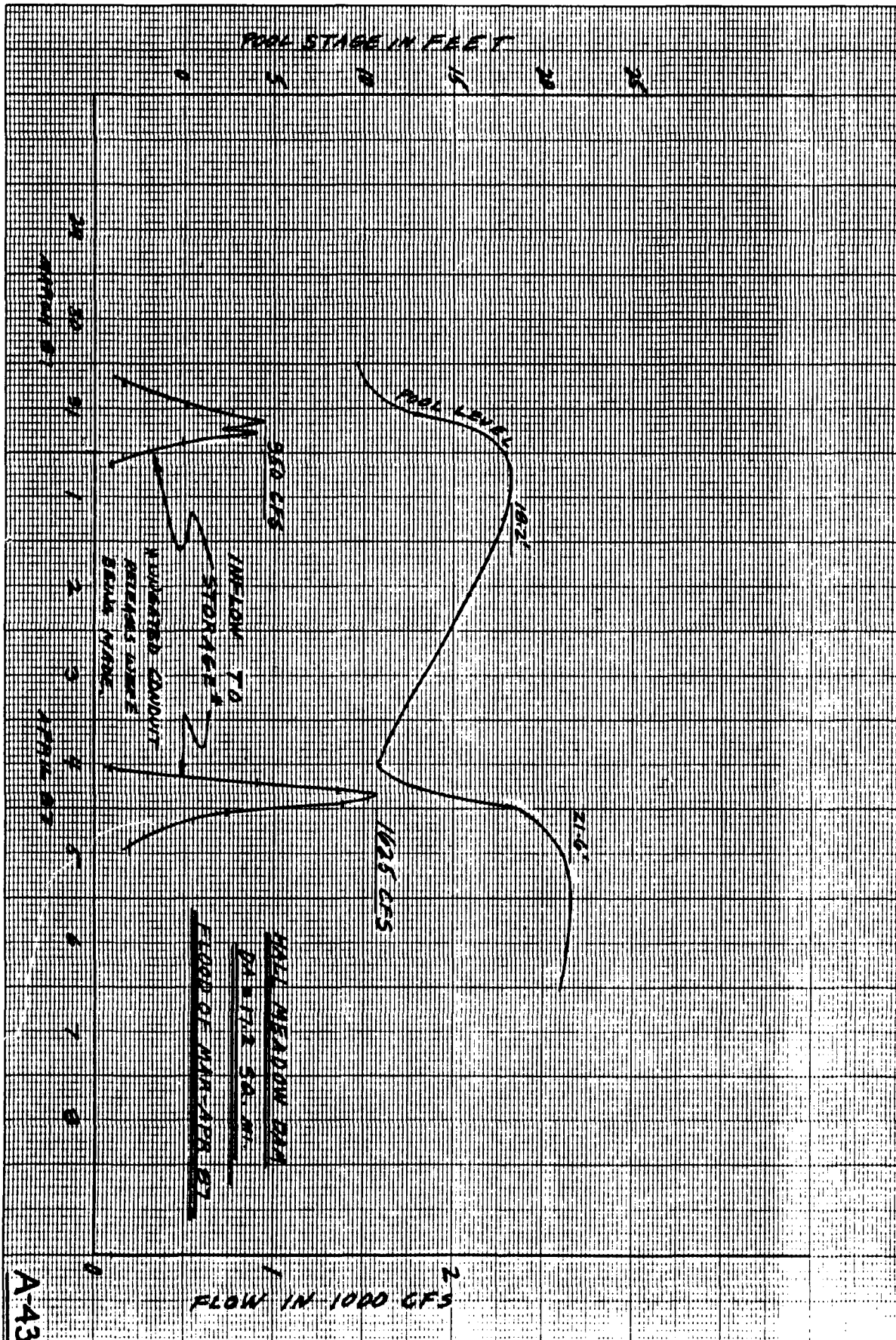


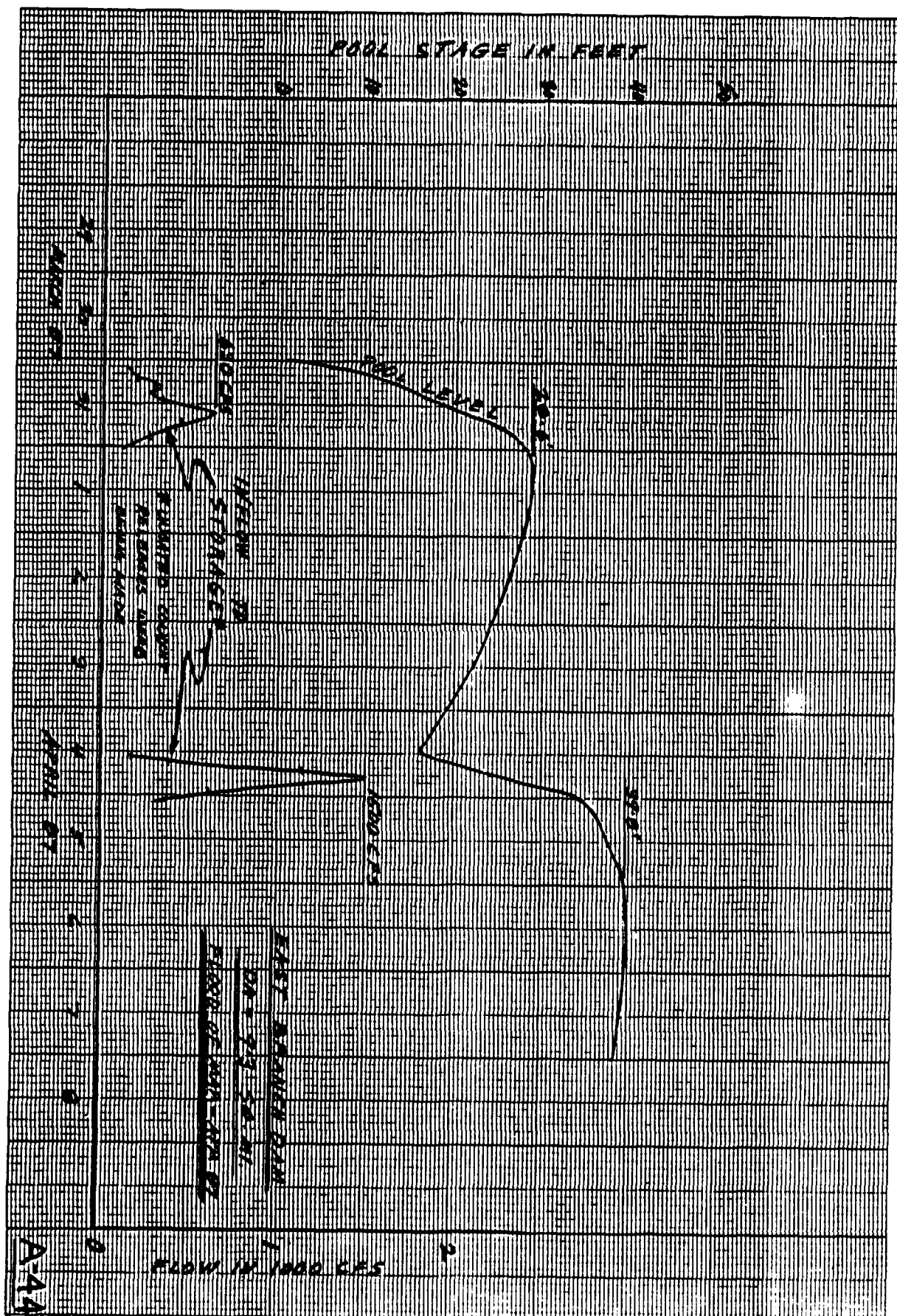


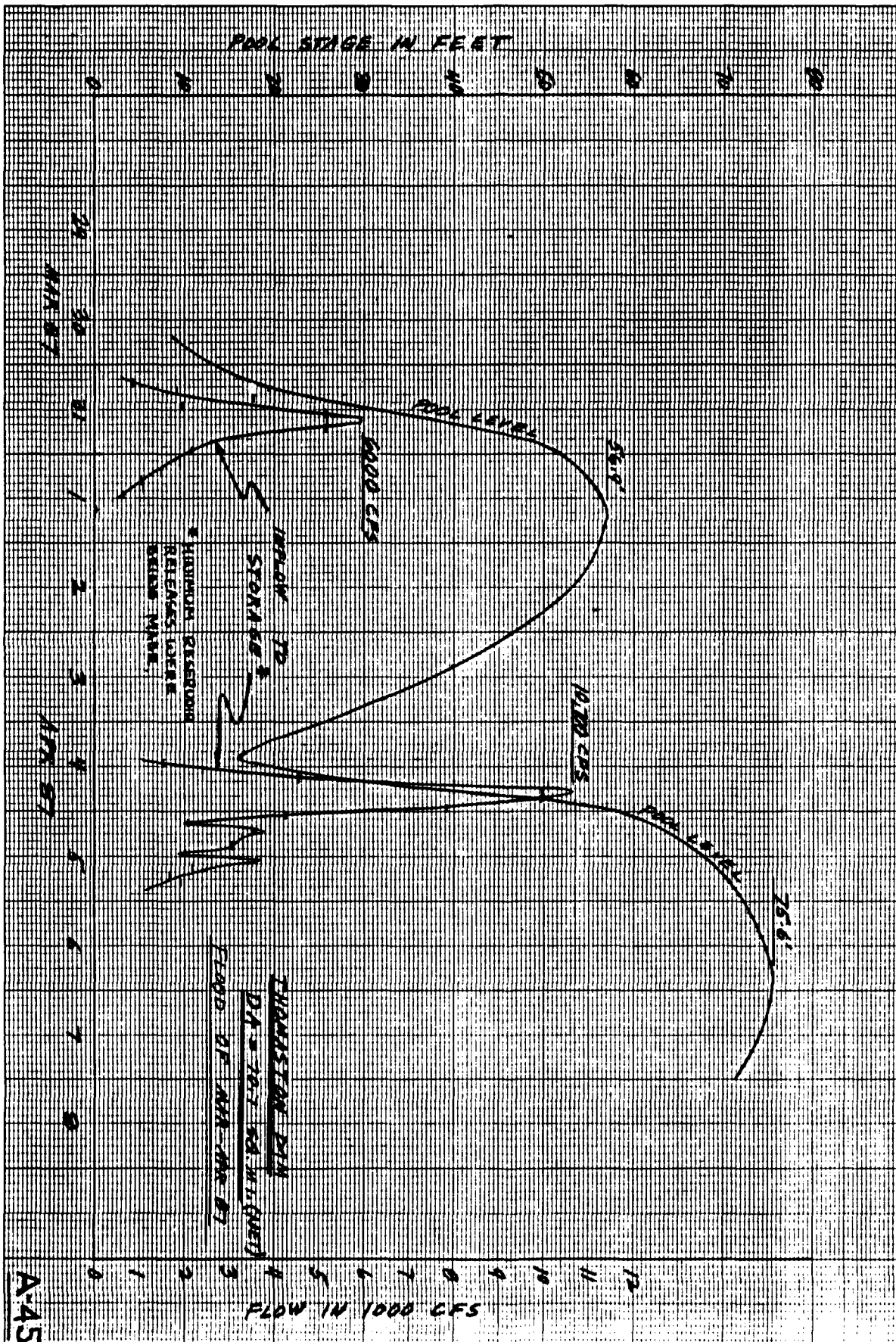


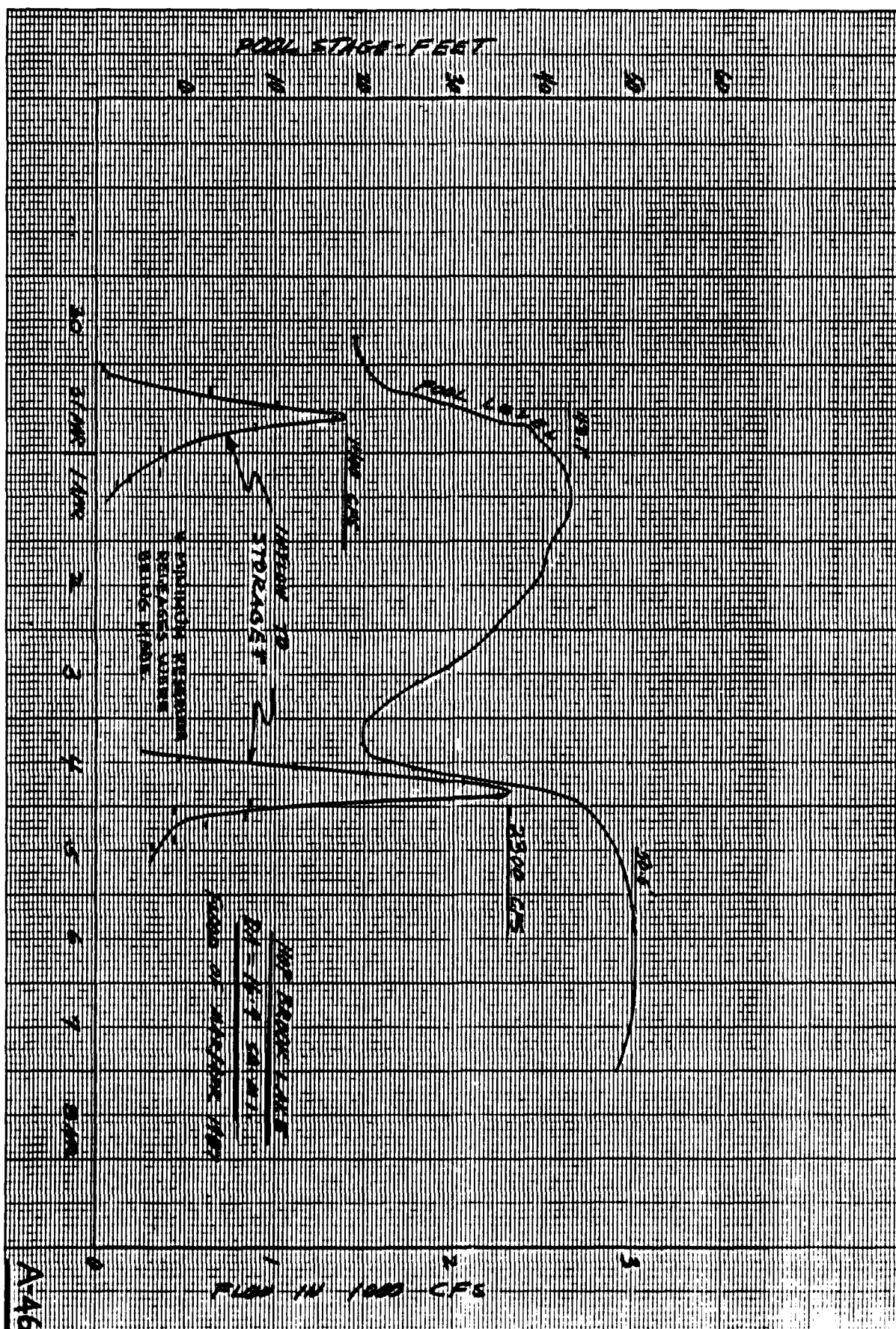


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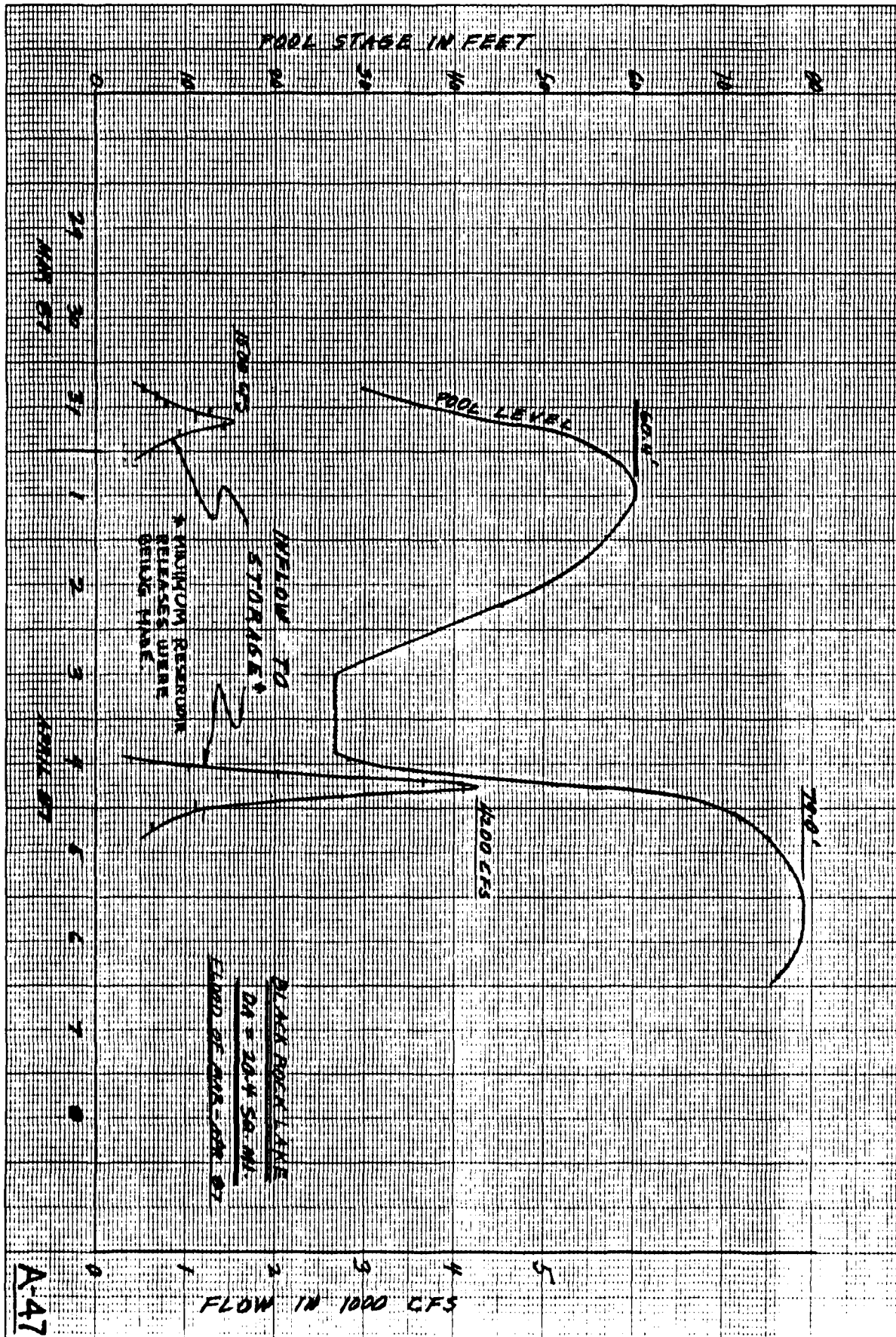


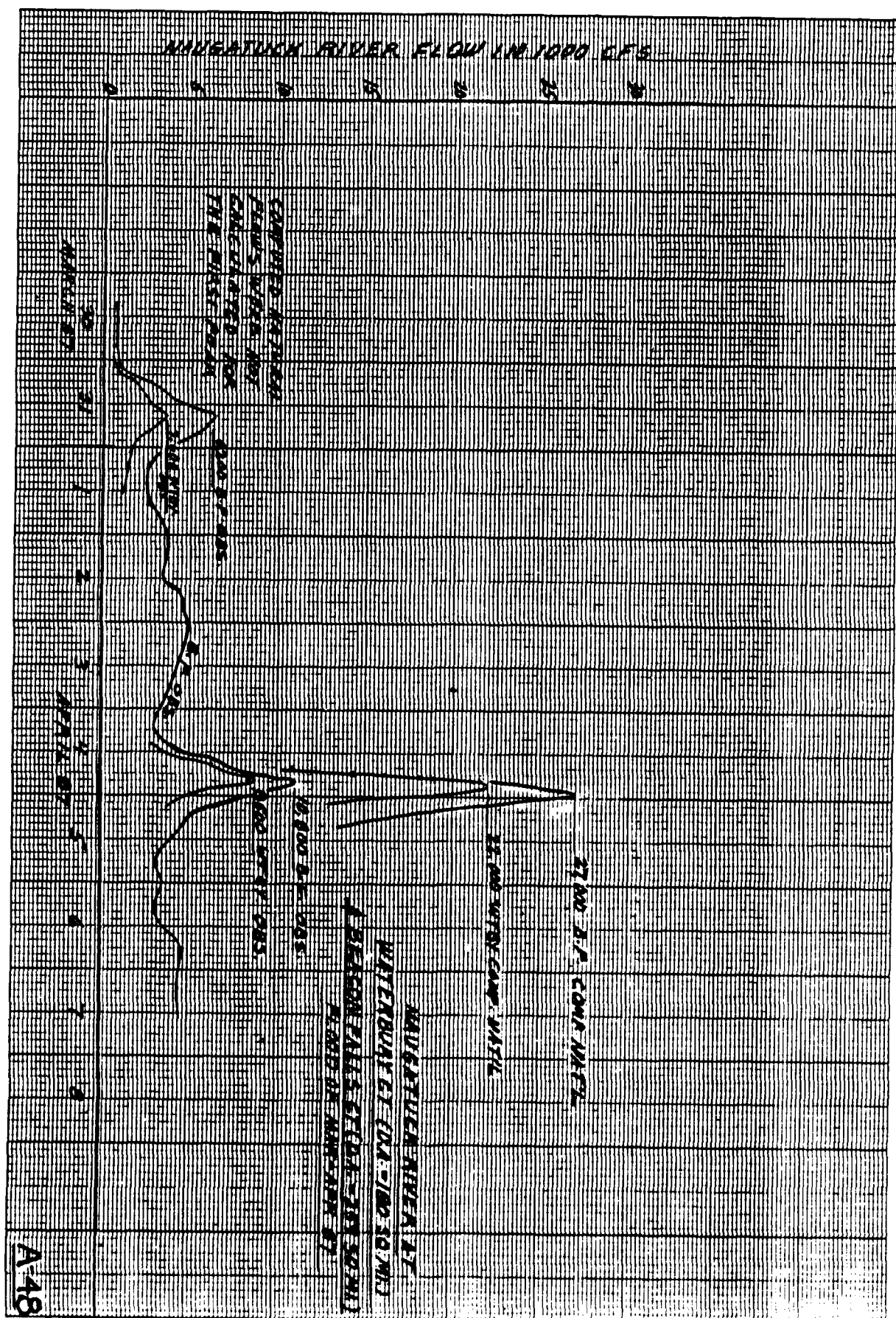






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